The

Electrical Review

VOL. CV. DECEMBER 27, 1929. No. 2718.

THE OLDEST ELECTRICAL PAPER. ESTABLISHED 1872.

Published every FRIDAY, Price 6d.

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Technical Editor: C. O. BRETTELLE, M.I.E.E.

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OFFICE: 4, LUDGATE HILL, LONDON, E.C.4.

Telegraphic Address: "AGEEKAY, CENT, LONDON." Code, A B C. Telephone No.: Central 8871 (5 lines).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s. 8d.; Canada, £1 12s. 6d. Colonial and Foreign, £2 1s. 6d. per annum. Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "Midland Bank, Newgate Street Branch."

For List of Foreign Agents for the ELECTRICAL REVIEW see Advertisement Supplement.

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Low-temperature Heating.

ALTHOUGH the more obvious uses of electricity have already been exploited in some degree, it is evident that we have as yet touched only the fringe of the possibilties of the conversion of electricity into heat as applied to industry, residences, and commercial buildings.

The two papers read before the I.E.E. last week had a common subject in so far as they related to the use of electricity at the relatively low temperature of 120 deg. F. or less. The authors, we think, quite easily made the point that the destruction of some four pounds of coal, at the very least, in order to obtain the heat equivalent of one pound, is justifiable in many instances by the nett advantages obtained. These advantages were shown to be cleanliness, ease of control, reduction in labour, and saving of space, which all possess economic value; to these the absence of combustion products in commercial and residential areas adds an important social value.

The paper by Lieut.-Col. S. E. Monkhouse and Mr. L. C. Grant gave particulars of several examples of the successful application of panel heating to large buildings, the most notable being Carliol House, the headquarters of the Newcastle-upon-Tyne Electric Supply Company, and Railway House, Broadway, Westminster, the new offices of the London Underground Railways. The heating installation at the latter building was fully described in our issue of September 20th.

In all these cases advantage has been taken of the principle of storage in the easiest and cheapest form in which electricity can be stored, *viz.*, the heating of water, by which means also the load factor of the system has been improved.

Mr. T. G. N. Haldane, on the other hand, calls in latent heat to redress the heat balance of the power station. He claims efficiencies of upwards of 300 per cent. for his heat pump, which is in essence a reversed-cycle refrigerating plant. Although such efficiencies, as the author points out, are not true thermodynamic efficiencies, they do represent the practical results of the process.

The connection of the heat-pump with electricity is that it would obviously be driven by an electric motor. The

motor would, however, have to run continuously, save for an hour or so over the highest peak of the load, but at the same time owing to the high efficiency, as defined by the author, the actual cost per 3,410 B.th.u. would be appreciably less than that obtainable by thermal storage. The principles set out in the paper have been checked by actual experience in the operation of such a plant for domestic heating. Another use for the heat pump is suggested by the fact that the highest efficiency is obtainable when the difference in temperature between the cooling media is least; thus its use for warming the water of public baths appears eminently practical, and we understand that developments are pending in this direction.

Valuable as these papers are for the information they give on a subject of first-class importance, it seems to us that perhaps the greatest service the authors have done to the industry is to provide examples of faith expressing itself in works. On the one hand, an electricity supply undertaking heats its offices electrically by what is believed to be the largest installation of its kind in the world; on the other, an electrical engineer uses the method he advocates in his own home.

Trade with India.

IN Indian commercial circles, says Mr. T. M. Ainscough, H.M. Senior British Trade Commissioner in that great Dependency, there is very little sentiment in business—price is the controlling factor. He told the members of the Royal Empire Society at a luncheon held in London last week that our proportion of India's import trade was now considerably lower than it was in pre-war days (45 per cent. now as compared with 63 per cent.) for various reasons, one of which was a temporarily reduced demand for textile machinery, railway stores, and other British specialities, while another was the non-adjustment of the market to the post-war level of prices, especially for British high-grade productions.

The menace of foreign competition was present in all trades. Increased business was being done by Germany, the United States, Japan and other countries, and the Indian Government, while determined to buy in the cheapest market, was showing a preference to Indian-made goods. Mr. Ainscough reiterated the standard advice to the British manufacturer about taking personal interest in the market, recognising that the question of distribution of goods was a problem to be seriously faced; he emphasised the need for technical knowledge in the marketing of machinery and the need for appreciating that to hold or capture the Indian market, large expenditure and much trouble were inevitable.

The pending introduction of a new purchasing system by the Government of India will make matters even more difficult for British exporters. Some details of the scheme are mentioned in the " Business Notes " section of this issue. From these it will be seen that apart from special requirements, which may be dealt with by the India Store Department in London, British manufacturers will be on more equal terms with their foreign competitors. The rules do not appear to consider preference for British goods merely on account of their origin. Indian or semi-Indian goods are the first choice, the criterion apparently being quality, not price; next in order come goods held in stock in India. It is thus becoming essential for British manufacturers to strengthen their position in India even to the extent of forming Indian companies with rupee capital, as advised by Mr. Ainscough in his last published annual report, which was reviewed in our issue of December 28th, 1928. Readers interested in the subject may find it worth while to refer back to this review (or to the report itself).

Accidents due to Electricity in Mines.

IN the annual report for 1928 of H.M. electrical inspector of mines, our customary summary of which is started in this issue, an analysis is made of the accidents in mines due to the use of electricity. There were 15 fatalities in 1928 coming under the two heads of shock (11) and fire-damp explosion (4), the highest figure since 1924. The average annual number of fatal accidents has, however, decreased during the last 11 years by 35 per cent. of the average for the previous 11 years, whereas the h.p. of motors installed has increased by about 70 per cent. Accidents in 1928 had their origin, as in other years, in disregard of regulations, ineffective supervision, inadequate maintenance, and carelessness on the part of operatives.

It is pointed out that before working on live conductors it is a legal requirement that the conductor shall be earthed. A common failing is illustrated by one accident in which the safety and reliability of an enclosed switchboard was discounted by subsequent additions entirely out of keeping with the standard of the original equipment. Nearly half of the non-fatal accidents were in connection with the use of trailing cables and plugs, and attention is drawn to the desirability of using a plug made in accordance with the requirements of the British Standard Specification. This specification ensures interchangeability as well as flame-proof enclosure; in addition, it provides for a mechanical interlock with the switchgear and, if desired, for an electrical interlock also.

Cookers and Cooking.

WHILE we do not necessarily associate ourselves with all the views expressed by " A Consumers' Engineer " in our " Electricity For The Home " section of this issue, we do most heartily welcome his article, first, as being likely to help all interested in the development of domestic electricity supply, and, secondly, as a warning to manufacturers of electric cooking apparatus against the possibility of their being enticed by present commercial successes into believing that the last word has been said on electric cooker design.

Our contributor asserts that cookers are being put into service to-day which in a short space of time will disappoint their present buyers. If such proves to be the case very much harm indeed will be done to the supply industry in its work of domestic electrification. The " electric idea " is beginning to capture the consideration of the public, and it would be suicidal at this stage to take unfair advantage of the consumer's willingness to try by serving him with apparatus that would not stand the test of time. We repeat what we have asserted time and again, that the electric cooker is now a thoroughly reliable and efficient apparatus, but any tendency to put on the market " shoddy " apparatus for the sake of cheapness should be vigorously discouraged.

That the primary function of the cooker is to cook, and not necessarily to be a piece of apparatus with the highest possible thermal characteristics, is a reminder that may prove more useful to the supply engineer than to the manufacturer; supply engineers are inherently advocates of thermal efficiency.

Perhaps the most interesting points in the article in question are the suggestions that the ultimately accepted boiling plate will be of the open type, and that the correct future method of design for the boiling plate will be to increase the area of application of the load, and not the intensity. The marked reduction in maintenance costs which has followed the introduction of the closed boiling plate has had the effect that supply engineers now " swear by " the closed plate, while manufacturers have repeatedly assured us that the ideal boiling plate will not be obtained until it is possible to concentrate a much higher loading in the area necessarily restricted by the size of the hob.

1930.

WITH this issue we complete another year's " Review " of electrical affairs. Week by week we have endeavoured to place before our readers a faithful record of outstanding developments, and to provide for them a feast of good things to assist them in adding to their professional knowledge and in conducting industry and trade more efficiently. Without looking backward into detail, we may say that on the whole there has been gratifying electrical progress and advance, and believing that the pace will be quickened in 1930, we wish all readers of these lines " A Happy and Prosperous New Year."

The Radiological Exhibition.

Finality in design is far from being attained; apparatus is, with some exceptions, being built increasingly on engineering lines; electrical safety is also a noticeable feature.

By E. H. W. BANNER, M.Sc., A.M.I.E.E., A.Inst.P.

THE exhibition of X-ray apparatus held at the Central Hall, Westminster, on December 4th, 5th, and 6th, has now become an annual fixture and an integral part of the annual meeting* of the British Institute of Radiology incorporated with the Röntgen Society. This year it was referred to by Mr. C. Thurstan Holland, president of the Institute, as the best British exhibition held, and much that is new was exhibited. To a prospective purchaser of X-ray apparatus such an exhibition is of the greatest value, as it enables all British makes and some foreign ones to be compared side by side. Further, there is more tendency on the part of the least progressive of the firms to increase and improve their standard, as out-of-date apparatus shows up badly in comparison with modern gear. The apparatus shown was practically entirely confined to medical purposes, as was to be expected, which fact might have conveyed the erroneous idea to engineers visiting the exhibition that other purposes for which X-rays are used are negligible. Actually this is far from being the case, as industrial applications are continually increasing, and also to physicists X-rays form an unparalleled weapon in the examination of the structure of matter.

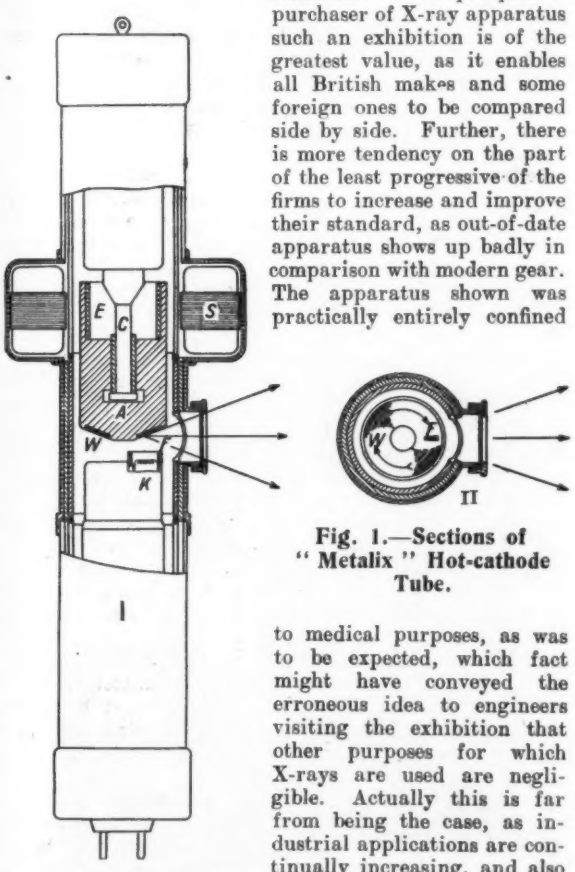


Fig. 1.—Sections of "Metalix" Hot-cathode Tube.

Modern X-ray generators now consist almost exclusively of the following: a high-voltage transformer, stepping up to about 100 kilovolts; a rectifier, either a thermionic valve or a mechanical commutator; and an X-ray tube of the thermionic or hot-cathode type. In some of the relatively small outfits the rectifier is dispensed with, as the X-ray tube is self-rectifying under certain conditions. In the early days of radiography, thirty odd years ago, induction coils and direct current were usual, while thermionic rectifiers and X-ray tubes were unknown, the tube being of the "gas" variety, which corresponded then to a good vacuum. Such tubes are still used to some extent, owing to their relative cheapness, and many hundreds were used during the 1914-18 war in hospitals at home and abroad.

The most important improvements in each of the above main items are as follows:—

Transformers.—These are definitely an engineer's job, and in general only small points of difference over earlier types are noticeable. Outputs tend to increase somewhat, and the main problem is to design a secondary winding for a high voltage in a small space, this limit being in evidence far more than the thermal one of keeping down the temperature rise.

A year ago a B.E.S.A. specification was issued for transformers for X-ray purposes, and there has already commenced a measure of standardisation of sizes, ratings, &c., although as most customers are medical men and unfamiliar with B.E.S.A. specifications it will be somewhat slow in becoming general. A number of manufacturers definitely make their transformers to the specification, and such practice can only be commended, as direct comparison is possible by means of the standard ratings, as engineers will agree.

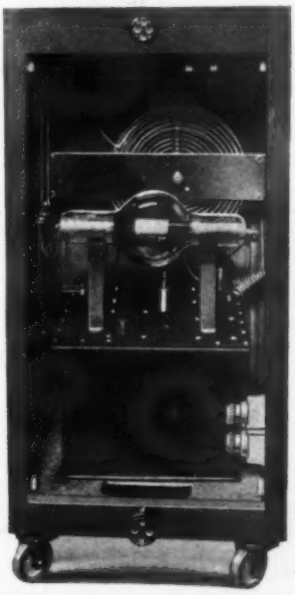


Fig. 2.—Valve Diathermy Set.

Rectifiers.—No marked alteration has been evident in the last few years. Most manufacturers supply sets with thermionic rectifiers and with mechanical rectifiers, the former being mostly in demand. The advantages of the thermionic valve type are absence of noise, smaller bulk, and no moving parts, whilst the mechanical rectifier has the advantage of greater robustness, indefinite life, and the possibility of passing only the peaks of the wave, so eliminating the useless lower voltages from the resulting unidirectional output. Valve rectifier sets require either one, two, or four valves for a single-phase supply, one valve providing half-wave rectification—with the exception of a special circuit which also utilises a condenser

* See ELEC. REV., December 6th, 1929, p. 1005.

and so obtains full-wave rectification—and two or four valves rectifying the whole wave. For three-phase circuits an arrangement of six valves gives a very smooth output without recourse to condensers.

An X-ray tube is itself a rectifier, provided that its anode is at a low temperature relatively to the cathode or filament, so that for small outfits intermittently worked no rectifier is necessary, and several sets are available

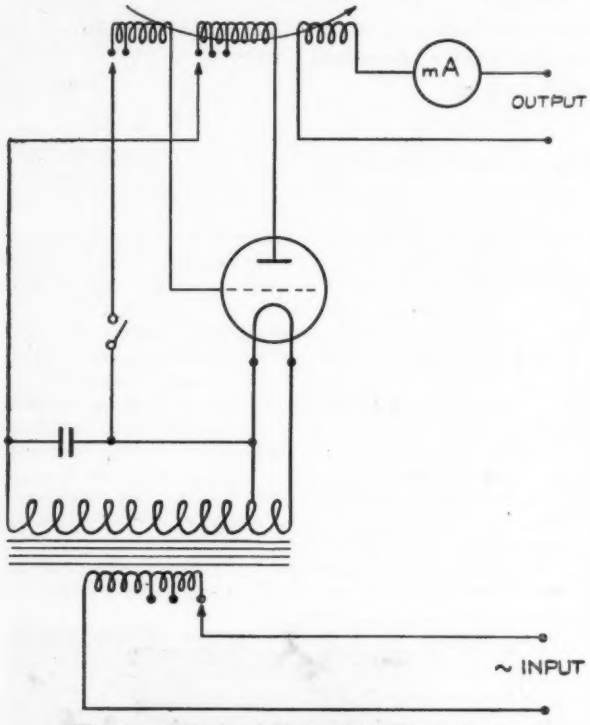


Fig. 3.—Circuit of Valve Diathermy Set.

having this advantage, which is particularly noticeable in portable and dental sets. The increased use of valve rectifiers over mechanical ones may seem at first sight to be a departure from engineering plant, but, when it is realised that increasing numbers of mercury-arc rectifiers are satisfactorily used in modern sub-stations, it will be admitted that it is not departing from present-day engineering practice.

X-ray Tubes.—The only marked advance on previous tubes is the new Philips tube with a rotating anode. A small area of the anode is actually used during an exposure, and, as the temperature of this limits the loading, it is obvious that a rotating anode will expose a greater area of the anode to the bombardment from the filament, whilst retaining the small focal spot or working area necessary for good definition of the radiograph.

The Coolidge tube, the original thermionic tube, is now used to a less extent in this country on account of the main advantage of the " Metalix," a Philips tube, which embodies its own X-ray protection and is therefore smaller when installed. In addition, its line focus, as distinct from the point focus, is claimed to give better results. The Muller tube is also a line focus tube, the residual gas being helium.

General.—The rest of the apparatus is chiefly of medical interest, and includes some form of couch with the tube above or below, and a vertical screening stand in which a patient may stand or sit; the progress of an opaque meal may be watched on the screen and radiographed as required, or the lungs may be examined.

Old sets had a large lead-rubber lined tube-box and exposed high-voltage leads. The " Metalix " tube, being self-protected, needs no material opaque to the rays to house it, and in some sets the high-voltage leads are of the condenser type of flexible cable, so that no live conductor is within reach. When such gear as is mentioned above was used with an induction coil it was rare that more than an unpleasant shock was obtained by contact with the live conductors, but modern installations with large power transformers on supply mains are capable of dealing fatal shocks, and so require much more care in installation. Last year installations were described and shown in which the power unit was in a separate sub-station and the leads run quite out of reach of the operator and patient. Such a tendency is certainly good and in very large installations is becoming universal.

A few years ago an American firm showed a dental outfit in which the transformer and tube were contained in an earthed metal box, which was brought near the patient. This feature has now been extended to a larger set in which no high-voltage gear can possibly be touched. In addition, no X-rays emerge except through a glass window directed on to the part required. This set may prove to be the forerunner of a large number of installations of this type, both for small sets and for large hospitals, where each tube is part of a compact and independent unit.

New Apparatus Exhibited.

Although diathermy apparatus is by no means X-ray gear, it is mentioned here partly because a number of manufacturers exhibited such apparatus, but chiefly because the diathermy set, fig. 2, of Messrs. Phillip Creswick utilises a thermionic valve to generate its high-frequency oscillations, somewhat similar to a wireless transmitter and unlike other sets which use a spark generator. This set embodies a self-cooled valve having a dissipation of 500 watts, its working frequency being of the order of a million and a half cycles per second. Currents up to 1.5 amperes may be passed through a patient, the peculiarity of this high-frequency current being that no shock is felt, but a slow sensation of local warmth. Control is by means of a switch in the grid circuit, and its filament is excited from a tapping on the transformer secondary, fig. 3. The grid and anode coils, which are spirals, are both capable of variation by tappings directly on the coil.

A new set intended for deep therapy, by providing a current of 8 mA continuously at 180 kV peak, was exhibited by Messrs. A. E. Dean in their " Cheltenham " set, fig. 4. In this apparatus two condensers are used

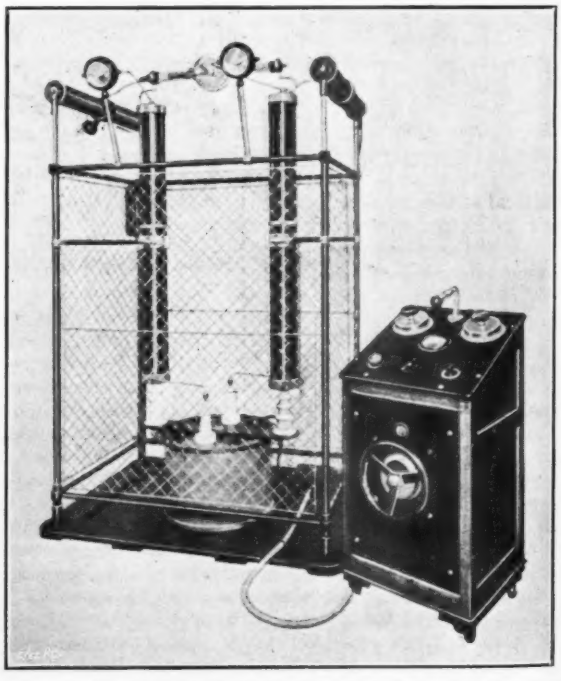


Fig. 4.—Therapy Set, One Valve, Two Condensers.

and a single rectifier. The transformer voltage is doubled by this means and a compact set encased in wire mesh results.

The " Simplex " unit is a transportable set containing its transformer in the mobile control table. The tube stand is also fixed to this so that the whole may be readily moved on its wheels. Its rated output is 30 mA at 90 kilovolts peak. The " Radiostat " unit is a larger plant with the generating equipment—transformer and mechanical rectifier driven by a synchronous motor—mounted in a wooden cabinet, on top of which is a point-

point spark gap, as used in the old days with induction coil sets, and a milliammeter showing current through the X-ray tube. This has a rated output of 100 mA. A four-valve set was also shown, the valves being mounted vertically above the transformer, the whole being again in a wooden case with a point-point spark gap and instruments on the top. A useful feature of the valve sets of this firm is a filament stabiliser, by means of which the

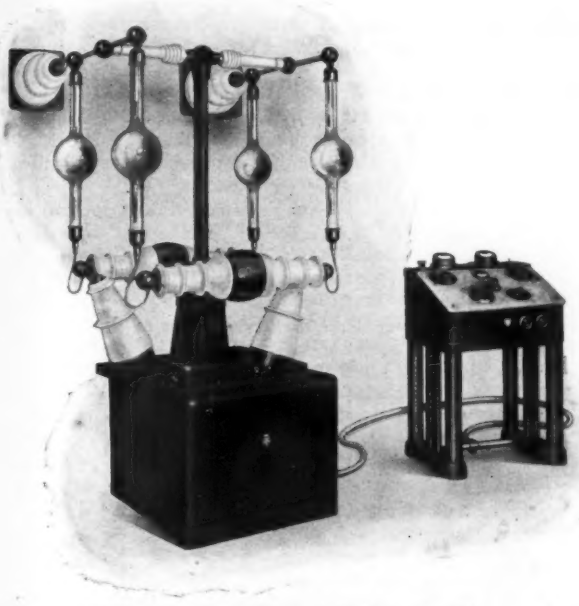


Fig. 5.—A 4-Valve G.R.S.A. Outfit.

rectifier filament current is maintained at its correct value during an exposure.

There is a tendency towards eliminating wood cases and using metal construction, as in the " Cheltenham " set, although this is at present not complete. Instruments used in high-voltage circuits are screened electrostatically, so that the pointers do not pick up stray charges and cause spurious readings, as it is not always possible to place the instruments in an earthed lead. A vertical screening stand for two metres distance was also shown.

The General Radiological and Surgical Apparatus Co. supplies almost all Germany and a number of other countries on the Continent, and thus has a very large market. The chief new feature, from an engineering standpoint, of the company's outfits is the abolition of the auto-transformer generally used with the primary of the main transformer, the tapping being directly on the primary winding. For large sets relay control from the mobile control cabinet is included, and the absence of the auto-transformer is coupled with the absence of rheostats from the filament transformer controls, tapping being directly on the bared primary winding by a sliding switch. Much more uniform variation of voltage by these means is claimed. A large three-phase set has close voltage regulation, resulting in the drop in voltage on load being only 1.5 kV per 100 mA of tube current, and the general feature of independent controls for screening and radiography are also incorporated. Another unit was the " Mobile Heliodor," the whole of which apparatus is mounted on a stand capable of being wheeled about. Its maximum voltage is 93 kV, and its rating 30 mA at 85 kV, and 40 mA at 65 kV. The " Power Heliodor " is a heavier apparatus, contained in a metal case and delivering 150 mA at 100 kV. A four-valve set has its rectifying valves mounted directly on the transformer, the whole being enclosed, fig. 5.

As an example of six-foot radiography a screening stand called the " Tele-orthoscope " was shown. This provides for a longitudinal movement of the tube away from the patient, together with tilting and swinging movements, so that oblique screening or radiography may be carried out. The whole moving system is balanced by adjustable springs instead of counterweights, in order to make the set readily responsive to the touch, an aid to rapid diagnosis. This firm also showed a dosimeter for measuring the amount of radiation actually received by a patient undergoing X-ray therapy.

British-made thermionic rectifiers are incorporated in the valve sets of Messrs. Newton and Wright (the only other British-made valves being those made by the Osram Valve Co.) who have recently equipped a large installation at the Ruchill Fever Hospital, Glasgow. A four-valve set of the conventional type, fig. 6, was a part of their exhibit, and although mechanically-rectified plants were not on view the demand for them approaches that for valve sets. The single-valve set is in greatest demand, a feature which is fairly general.

A novel exhibit was a vertical stand arranged especially for stereoscopic radiography. Two X-ray tubes are arranged side by side with their rays facing the patient and the film, and separated from each other by a short distance; both tubes are connected to the high-voltage supply, but the filaments are in series with a switch which short circuits either at will. An exposure is made with one tube; the film is then moved and a fresh one brought into the field, whilst the switch is being changed over to energise the other tube, it being realised that only the tube with the hot filament will emit X-rays, and, as the two have different view points, the films, when viewed in a stereoscope, give a very good binocular image.

Overhead high-voltage gear includes a special selector switch, by means of which an outfit may be switched to

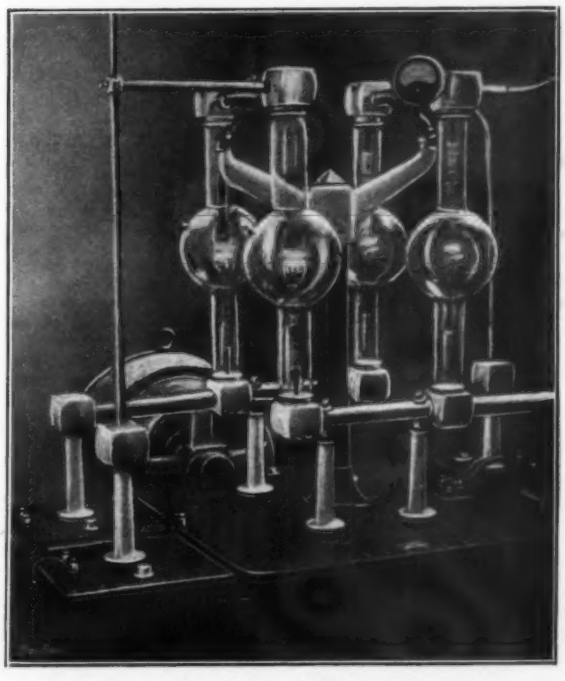


Fig. 6.—A 4-Valve " Tetravalve " Set.

a screening stand, a tube above a couch, or another one below. Each position is obtained by pulling a cord marked suitably, so that no mistake is possible.

The " Metalix " tube is probably the most important item of Messrs. Philips Lamps, Ltd., for X-ray work, and new tubes include those for powers of 2½, 6, and 10 kW. Generally speaking, the penetration and quantity of X-rays is limited by the X-ray tube, although for medical purposes these limits are high enough with present technique. The only outstanding progress is the design of a rotating-anode tube of the " Metalix " type, particulars of which will be detailed later, as a paper was read on this tube at the meeting. An illustration of this firm's hot-cathode tube is given in fig. 1. The latest X-ray device of this firm is the dental set, fig. 7, which

provides an alternative: for wall and for floor mounting. Each is somewhat on the lines of the "Metalix" portable shown last year, the transformer being small and compact and connected to the self-rectifying tube by condenser leads having their flexible metal sheaths earthed, so that complete electrical as well as

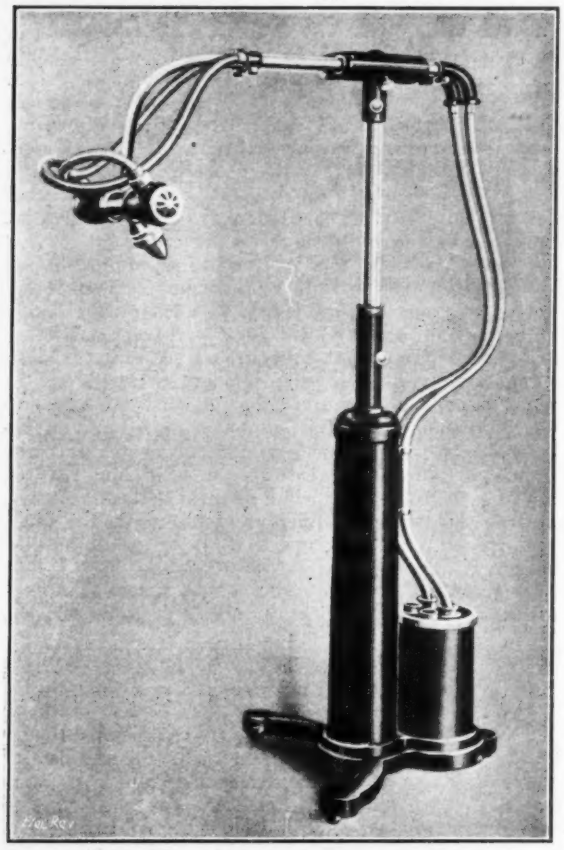


Fig. 7.—Pedestal Pattern Dental Set.

X-ray protection is assured. The power required from the mains is so small that ordinary domestic outlets are suitable, if a.c., and any usual supply voltage. For use on d.c. mains a small portable rotary convertor is available.

Another novel feature is an instrument reading milliampere-seconds used for timing exposures; it consists of a hot-wire movement having a time lag so that a given current maintained continuously will indicate an increasingly greater reading.

A set incorporating two different supplies was shown by Messrs. Schall and Son. It comprises a transformer, valve, and two condensers. For radiography the condensers are not used, and the valve is in series with the tube. An output of over 100 mA at 70-80 kV peak can be obtained, whilst for therapy a smaller current of 4-8 mA at up to 200 kV peak is available. With this connection, due to Villard, the condensers are in series with the transformer terminals, and the valve is connected in parallel with, and back-to-back to, the tube. A switch attached to the housing serves to change the connections from one to the other, and at the same time to change the controls on the trolley, so that, when set for screening, only the controls used for screening are operable. A further switch on the top of the cabinet is a selector switch for connecting the output to any required circuit. Voltage control is by tapping switches on the auto-transformer, and a contactor is used as a main switch. A one-valve set is found to be the most popular, and for chest screening work in particular six-foot radiography (or teleradiography) is on the increase. This tendency was first made public last year by Mr. W. E. Schall at the annual meeting.

(To be concluded.)

High-Voltage Laboratory.

German Two-million Volt 1,200-kVA Equipment.

WHAT is claimed to be the first laboratory for electrical testing at pressures up to two million volts has lately been completed at the transformer works of the Koch & Sterzel Gesellschaft, at Mickten, Dresden, Saxony. That the firm has for many years realised the importance of having adequate facilities for testing electrical equipment is indicated by the steady advance that has taken place; it is interesting to record that it had a laboratory equipped for tests up to 50 kVA capacity at pressures up to 500,000 V as long ago as 1918, which was followed in 1922 with one capable of permitting tests up to a million volts and 200 kVA, while now the capacity has been increased to two-million volts and 1,200 kVA at 50 periods.

The inauguration of the new department took place in the presence of a number of members of the Association of Saxon Electricity Generating Stations and of the Dresden Association of Electrical Engineers. The visitors were received by Prof. Dr. Eng. Koch, who referred in a short introductory address to the continuous progress that is being made in the transmission electrically of power at high voltages, while Dr. Eng. Reiche explained that the new department had become necessary owing to the fact that power transmission installations at a pressure of 220 kV were now coming into general use in Germany, and so necessitated the provision of means for testing the insulators and other equipment necessary for such installations.

In the Koch-Sterzel one-million volt plant three series-connected 333-kV transformers were employed, whereas in the new laboratory there are five, each having a capacity of 400 kV. So far no details of the transformers and

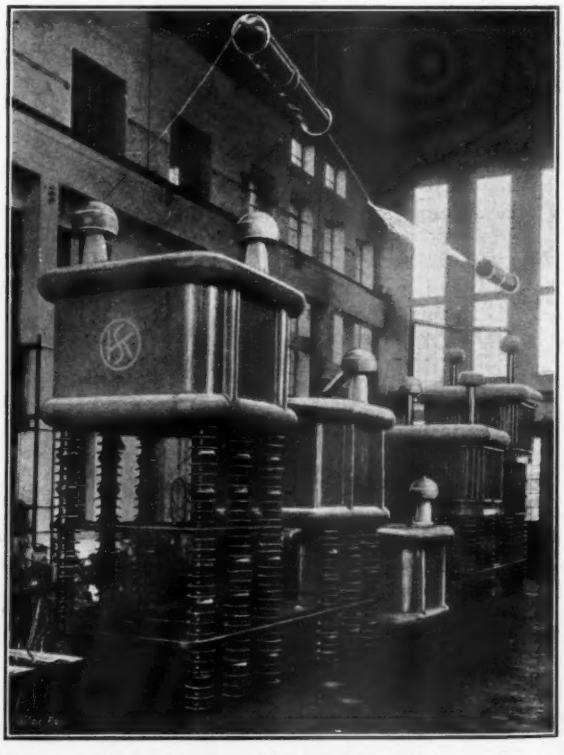


Fig. 1.—Two-million Volt Transformers in Germany.

their connections have been made public, but an idea of their general appearance will be gathered from the accompanying illustration (fig. 1). It will be seen, too, that they are arranged at different heights on insulating stands to correspond with the increase in voltage to earth when the transformers are in cascade connection.

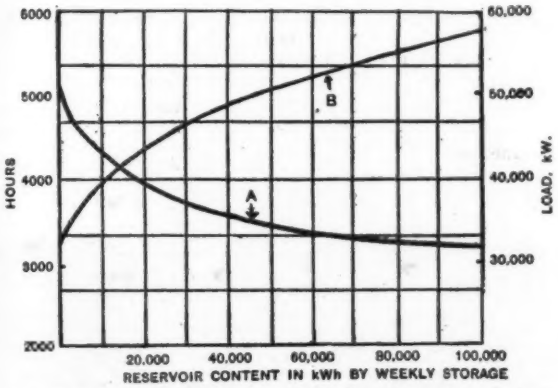
For the benefit of the visitors, the plant was shown in operation, when a two-million volt spark across a gap of no less than 16 ft. was obtained.

Hydraulic Power Accumulation.

A brief outline of the applications and underlying principles of hydraulic power-accumulating installations, such as are being so widely adopted on the Continent, with reference to the possibilities of this system of water-power storage as applied to steam generating stations

By A. PAGE, B.Sc., A.M.I.E.E., A.M.I.Mech.E.

WATER has always been the greatest essential of mankind. Without it existence on earth would have been impossible, and as water has served our ancestors so faithfully in many ways, it is but natural that new uses for it should be found in the future.



A=Load on steam turbo-generators. B=Duration of operation of steam turbines. Overall energy conversion efficiency=60 per cent.

Fig. 1.—Decrease in Generator Capacity with Increase in Storage.

However, with new ways new difficulties are encountered, and we in this country are struggling to overcome one such difficulty in the form of plant load factor by the erection of the national transmission grid.

The present intention in respect of the grid is not so much to transit bulk supplies of power over long distances as rather to ensure that the most efficient stations do the bulk of the producing, and, most important, to provide emergency supplies with the minimum of stand-by plant. Once in commission, however, further practical uses for the grid can be expected, not the least of which *may* be the transmission of power in bulk to sites suitable for its storage until such periods as plant capacity may be stressed. A somewhat analogous problem has occurred on the continent of Europe in connection with large hydro-electric schemes, where this question is of very much more importance. First, there is the exceptional capital outlay on water-power installations, which may be from five to seven times the cost of the equivalent capacity in steam plant. In fact, it is generally assumed that the interest on the additional invested capital of such an installation takes the place of the coal bills of steam stations. Hence, to provide stand-by plant for a hydro scheme is somewhat synonymous to maintaining a steam turbine under full-load steam without normally securing any useful output. In this respect, therefore, it behoves the hydraulic engineer to provide only such plant as is absolutely necessary, and to arrange for it to be in useful commission for as long periods as possible.

Of course, a further aspect of hydro schemes is the utilisation completely of all the water power available, as the overall efficiency should be gauged by the quantity of raw power available and the amount of power made use of. If the maxima and minima of supply and demand synchronised and the machinery employed was 100 per cent. efficient, the overall efficiency would also be 100 per cent. Now, if the characteristics of supply and demand were not identical, there would be a surplus of power at times of low load, and insufficient power at times of peak load, so that the earning capacity of the installation would be adversely affected. The advantages of introducing a flywheel were recognised by the earliest engineers, and with the growth of large interlinked power systems its necessity, whilst not so evident, is nevertheless present. As they are well informed on hydraulic matters, and as their generating stations already utilised to a great extent water power, it is but natural that the art of hydraulic accumulation should have been cradled by continental engineers. They determined that it was a comparatively simple matter to add a pumping set to an existing station and, during times of light load, to store water in an elevated position, thereby not only providing additional power for meeting peaks, but also utilising to its full extent all the water power available.

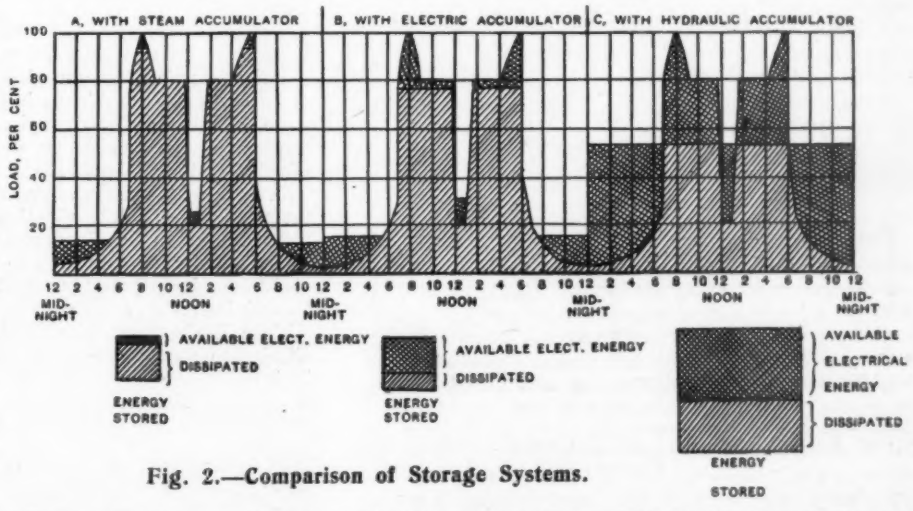
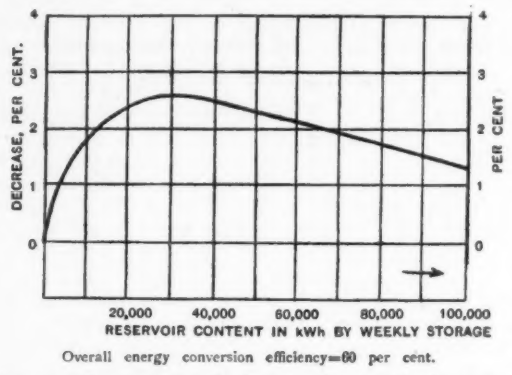


Fig. 2.—Comparison of Storage Systems.

To make the position clear, if 50,000 kW can be gene-

rated continuously from a certain water fall and the load to be met, assuming an extreme case, is 100,000 kW for 12 hours per day with no load during the remaining time, it is obvious that without accumulation only 600,000 kWh can be generated, whilst an equal amount runs to waste. Now, if during the no-load period energy were developed and employed in pumping at 100 per



Overall energy conversion efficiency=60 per cent.

Fig. 3.—Percentage Saving in Coal with Increased Storage.

cent. efficiency the tail-race water into a reservoir, all the power available would be utilised and the 100,000-kW load could be met by running, in addition to the ordinary sets, a water turbine connected to the declutched motor of the pump in such a manner as to drive it as a generator. By this means the plant load factor would be raised from 50 to 100 per cent. From fig. 1 it will be seen that as the amount of energy stored increases, the load factor is proportionately improved, and the output required from the main generating sets becomes smaller. In other words, with the same sized generating sets a much greater peak can be met if hydraulic accumulation is employed and, instead of extending the generating station proper, it can be made to operate for longer periods on a base load, the energy stored being delivered to the network when necessary.

Installations of the above description were, of course, first employed at favourable sites and sometimes meant only the addition of a pump, motor, and water turbine to the existing plant. It is also obvious that the greater the pumping head, the smaller the size of pumps, turbines, and reservoir needed for the same storage capacity, so that instances are extant of raw water power having a low head being utilised for pumping water to a much higher head. In this manner the idea of power storage by water has become established practice and pumping sets absorbing 25,000 h.p. apiece are in operation.

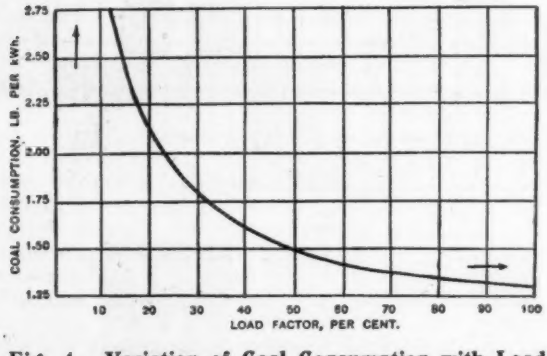
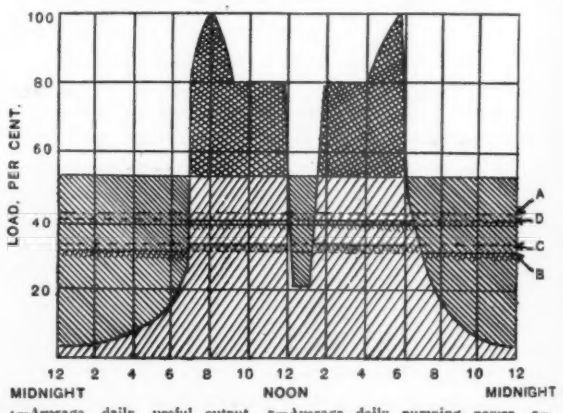


Fig. 4.—Variation of Coal Consumption with Load Factor.

On embarking on such schemes, other existing methods of power storage have come under review, the most prominent devices of the kind being the steam accumulator and the electric storage battery. The steam accumulator is being successfully employed in industries requiring process steam to even out the fluctuations in demand for steam and power, and in one notable instance in Berlin, Germany, it is being applied to a central steam electricity generating station, where 24 vertical accumulators are being erected to operate in conjunction with three 20,000-kW sets. The economy of such an installation has yet to be proved, and therefore it can only be meanwhile looked upon as being in the experimental stage. Its inherent weakness when large capacities are under consideration is the large and costly containers, in which almost 10 times the weight of water to the weight of steam must be stored. The insulation of the containers, which must of necessity be out-of-doors, is of no small importance, as well as the adverse effect on turbine efficiency of dry saturated steam varying in pressure between 200 and 20 lb. per sq. in. being employed. Further, if the turbines are to act as an *instantaneous* reserve, they must be constantly run idle, so that their no-load steam consumption has to be reckoned with. Under the most favourable conditions the estimated steam consumption of such an installation as that outlined above is stated to be 18.7 lb. per kWh, or from 60 to 65 per cent. greater than is normally obtained with ordinary sets, and this figure still does not take into account the no-load losses.

Electric storage batteries suffer seriously from the burden of heavy capital and maintenance costs, but what is more important in their case is that they can only deliver and receive direct current, which is seldom applicable to large networks except by the introduction of motor generators, which results in further cost and



A=Average daily useful output. B=Average daily pumping power. C=Average daily turbine output by daily storage. D=Average daily turbine output by weekly storage.

Fig. 5.—Comparison of Power Obtained by Weekly and Daily Storage.

loss of efficiency. To meet peak loads, the use of Diesel engines has been suggested, but their bulk and cost alone practically rule them out of count, not to mention the fuel cost, which may be as high as 0.4d. per kWh. If large high-speed Diesel engines became practical, or, better still, if an efficient gas turbine were invented, then admittedly they might offer a suitable alternative, but under the present circumstances they cannot seriously compete in this field.* For their manipulation they also require several skilled operators, who must always be in attendance if the plant is to be retained in reserve, and, whilst it is claimed they can start in from 6 to 10 minutes, a much longer starting time is normally desirable.

Even if the main disadvantages of all the systems alluded to were successfully overcome, they would still be inferior to water-power storage, as, unless they were of exceptional size, they could not hope to cover more than a small part of the actual peaks. Against this, it is possible so to proportion the reservoir of an hydraulic-accumulating installation that the main power sets are continually operated at almost 100 per cent. load factor without unduly increasing the size of the additional pumping sets. This is brought out more clearly in fig. 2, which is fairly representative of the possibilities of the various systems and indicates the substantial manner in which hydraulic storage can be employed for smoothing

* See ELEC. REV., June, 14th, p. 1074; June 21st, p. 1119; July 19th, p. 134, 1929.

out the load curve. The importance of a good load factor needs little comment, except to add that, as the Parson's line of any station is made up of a constant no-load loss plus an amount dependent on output, the coal consumption per kWh is also bound to decrease with the load factor. The subject of the economy of hydraulic accumulation as applied to steam stations was raised at

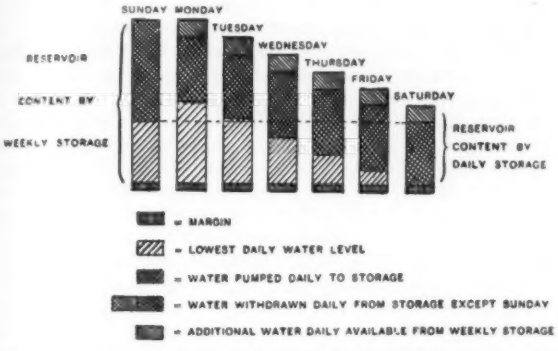


Fig. 6.—Comparison of Reservoir Capacity by Weekly and Daily Storage.

the World Power Conference in 1926, and as a result a detailed investigation of the position was published by Mr. A. Maas in the *Water Power Year Book*, 1925-26, the conclusions of which are summarised in fig. 3. From that curve it will be appreciated that with an overall storage efficiency of 60 per cent. an improvement in steam consumption of nearly 3 per cent. can be expected.

At this stage it is important to note that the gain in efficiency is not progressive, but there appears to be a definite economical storage capacity for every installation beyond which an increase in energy stored may result in a loss of efficiency. This fact will be appreciated when the extreme case is considered of storing all the energy before it is delivered to the network, as in such circumstances there would be a definite loss equivalent to the inefficiency of conversion. The prevailing load factor in this country is in the neighbourhood of 30 per cent., which, as fig. 4 indicates, is on the steep part of the load factor—coal consumption curve. Therefore, the improvement in coal consumption is not so marked at the higher load factors as at the lower ones, and at a particular point the additional loss in energy conversion compensates for the decrease in coal consumption. Now, if capital charges per kWh were plotted along with the coal costs on a basis of load factor, they would form parallel curves of a similar contour to the coal consumption characteristic shown in fig. 4, so that the above argument applies equally to the cost per kWh generated.

A further important feature of water-power storage is that the energy can be made practically instantaneously available without incurring any additional losses, or no-load losses, and it therefore has a decided advantage over such systems as steam accumulators. Its application in this country should be further assisted by the erection of the grid, as some of the transmission lines will undoubtedly traverse country decidedly favourable for hydraulic storage. In fact, the choice of sites can be arranged almost irrespective of the power stations and of the localities of demand, except in so far as transmission losses enter into account. There will naturally be an economic limit to the distances between power station, storage site, and consumer, but the available radius will permit of a reasonable latitude in the choice of site. It must not, of course, be considered that only heads of 1,000 feet or more are essential, as some existing installations (Hemfurth) are operating economically under only 100- or 150-foot heads, and in some cases a 70-foot head is suggested as practical. It goes without saying that the higher the head the smaller the entire plant and reservoir need be for the same output, as less water has to be pumped, and with a higher head a higher speed can be employed. Also, as the circulation of water is less, the overall efficiency is greater, but in spite of this fact medium-pressure heads form quite a sound proposition. This remark also applies to the question of capacity, as although with large systems large hydraulic accumulators are the rule (at Neiderwartha the pumps are rated at 25,000 h.p. each), it is nevertheless true that in certain instances (Mittweida and Tubingen) it has been found economical to install pumps of only 300 or 400 h.p. capacity. No hard and fast rules can be stated for the range and method of application, as they depend on so many factors, which in each case require individual consideration.

A point having an important bearing on the matter is the method of storage, *i.e.*, whether weekly or daily storage is employed. Most municipal power systems have a daily characteristic load curve in summer much as shown in fig. 5, the peaks representing the time when industrial load is carried. On Sundays and holidays a very small steady load usually prevails, so that, if desired, those periods, in addition to the daily periods of light load, can be employed for storing energy. By accumulation at week-ends one-sixth of the water pumped can be utilised during week days; fig. 6 shows the distribution of storage capacity over one week under such circumstances. The cross-shaded parts indicate the water pumped per day, which, except on Sundays, is re-utilised daily, together with the aforementioned part of Sunday's storage. Under daily storage conditions the dotted line would represent the capacity of the reservoir, which would be filled and emptied once per 24 hours.

Employing efficiency factors of 80 per cent. for the pump, 82 per cent. for the turbine, 97 per cent. for the pipe-work when pumping, and 94 per cent. for the pipe-work when under turbine operation, it can be shown that if the pumps operate for 14 hours per day and the water turbines for 10 hours per day, then the turbine load carried will equal 1.08 times the hourly pumping load. Letting x equal the ratio of pumping load to pumping head, the daily quantity of water pumped in cubic metres per hour (1 m³ = 35.3 ft.³) will equal 3,000 x. Now, if in addition to the above it is possible to pump at the same rate on Sunday for 22 hours, the size of the reservoir required will equal 7,500 x, or 150 per cent. greater than with daily storage alone. The daily water quantity then available for power generation will equal 3,750 x, or an addition of one-sixth of 4,500 x, which is pumped on Sunday. From this it will be seen that 25 per cent. greater output can be obtained by pumping at week-ends, but a much greater reservoir is necessary. To raise the daily capacity 1 per cent. by week-end storage means 6 per cent. greater reservoir

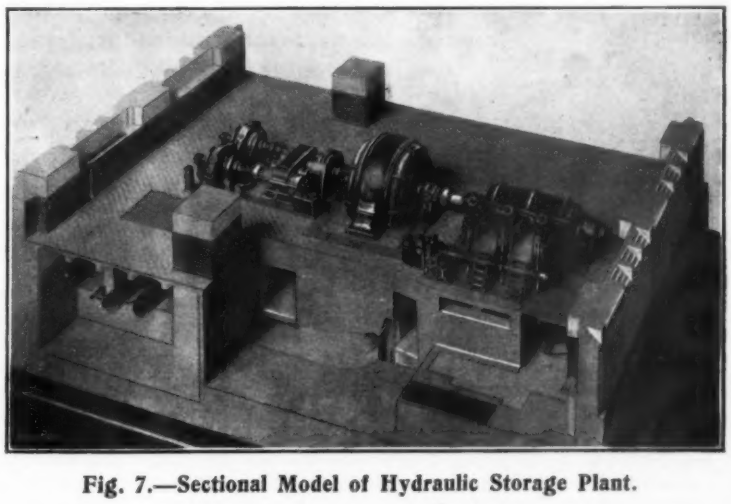


Fig. 7.—Sectional Model of Hydraulic Storage Plant.

capacity, and experience has shown that the most economical size of reservoir is in the neighbourhood of 4,000 x.

In fig. 5 the chain-dotted line A represents the average hourly load delivered to the network; line B gives the average pumping capacity during the 14 hours of pumping. With daily storage, line C would indicate the average power returned to the network over the 10 hours during which the turbines are in service, which, as already shown, would be 1.08 times the pumping load. If week-end storage were possible, the average turbine load delivered to the network would be increased to line D, which is 25 per cent. higher than line D.

Fig. 7 is a model representing a typical engine house for water-accumulation plant. On the right will be seen the pelton-wheel turbine, which has three runner wheels, each served by automatically-controlled needle jets. When delivering power to the network this turbine drives the adjacent synchronous motor as a generator, the large magnetic clutch of which, on the left-hand side, is out of action. When storing power the water turbine is shut off, the electric clutch energised, and the pumps on the extreme left are driven through intervening gearing by the generator now employed as a motor. In many instances the same pipe-line is used for conveying the water from the pumps to the reservoir and for returning the water later to the turbines. To maintain efficiency at partial loads the pumps are fitted with automatic vane-adjusting devices, so that the pumps are very similar to reversed spiral-casing water turbines. The reason for introducing two pumping sets in place of one is rather interesting. Assuming the individual pump efficiency to be 80 per cent., 63 per cent., and 37 per cent. at full, half, and quarter loads, respectively, if one set were employed and run at half load its efficiency would be 63 per cent., but by having two units and cutting out one pump entirely, 80 per cent. efficiency could still be maintained. Similarly, at a quarter of the full pumping capacity the efficiency will be raised from 37 to 63 per cent. by having the twin arrangement and running only one pump. The gear losses of such sets only amount to 1 or 2 per cent. and may be neglected, whilst an additional advantage of the subdivision of the pumping group is that in the event of a breakdown of one pump half the capacity is still available.

Owing to progressive improvement in the efficiencies of both pumps and water turbines, hydraulic accumulation is coming much more to the fore. Water turbines are already in operation giving 93 per cent. efficiency at full load and 88 per cent. at half load, whilst the efficiency of large storage pumps is in the neighbourhood of 86 per cent., so that an overall efficiency of from 65 to 70 per cent. can be realised by this method of storage. Even this loss is to a certain extent discounted by the improved steam consumption resulting from the higher load factor, so that there is much to recommend its adoption, even in this country. Provided a suitable site is available, that is, one having upwards of 70 ft. head and located reasonably near the power system, then we already have to hand a means of improving our load factor far beyond the most optimistic expectations we may harbour for off-peak load tariffs.

Electricity for the Home.

A constructive criticism of the present methods and practices of manufacturers of electrical cooking apparatus, based on experience obtained from the supply undertaking's point of view.

By A CONSUMERS' ENGINEER.

THERE are at present at least thirty firms in Great Britain which are turning out electric cookers of one sort or another, and to one who has some knowledge of the early days of cooker development it is rather amazing to see them incorporating details which were abandoned years ago by the earlier makers. A manufacturers' representative, when asked recently why his firm had done a certain thing, replied: "because so and so asked for it, and if we do not do it for him someone else will, and we shall lose his order." The firm knew from its own experience that it was wrong, but it was forced into the position of having to do it, because some buyer, due to lack of experience, insisted on it.

The rapid increase in the number of undertakings buying cookers during the last few years seems to have created a position in which there is a comparatively large number of new manufacturers on the one hand, and new buyers on the other. These people, by weight of numbers, appear to be discounting the knowledge of design and the experience of cooker performance which have been acquired by the smaller number of manufacturers and buyers of longer experience.

That this is so appears to have been recognised by certain bodies, such as, for instance, the I.M.E.A. and the B.E.A.M.A., which some time ago set up a joint committee to consider cooker design. Whether or not the result of this committee's work will be sound will depend to a large degree on the relative representation of the two classes of maker and buyer, that is the old and the comparatively new.

The design and construction of a good cooker are not matters which can be done on an ordinary engineering basis. It is possible to design a cooker which may be perfect from the point of view of thermal efficiency, for instance, and yet be a complete failure as a cooker from the users' point of view. Likewise, the selection of a good cooker cannot be made on the strength of laboratory tests, however comprehensive they may be. Such tests give some useful indications from which deductions may be drawn, but the choosing of a cooker is a matter of judgment more than anything else. Cookers are being put into service to-day which in a short space of time will disappoint their present buyers and their future users. This will do a lot of harm to the development of the cooking load, for a consumer who has tried an electric cooker and has not been satisfied is worse than one who has never used such apparatus. He will not try again in a year or two and, what is still worse, on the strength of his past experience he will deter future prospective users from trying something which may be much better in design and performance.

What then are the points which should be kept in mind by both the maker and buyer of a cooker? The first is that the primary function of a cooker is to cook, and not to be a piece of apparatus with the highest possible thermal characteristics. This does not mean that thermal efficiency is of no importance, but that it is not of such importance as many appear to think it to be at present. The second is what will be the condition and appearance of the cooker after it has been in service some years? It is all very well to say that such and such a cooker has a beautiful finish, but the point is whether that finish will last. Bear in mind that the probability is that for many years yet consumers will hire their cookers, and, if the cooker loses its nice finish when in service, it

will either come back to you, or else cost you money to recondition it. Fancy finishes should therefore be regarded with caution. It must further be borne in mind, in this connection, that electric cooking attracts the "crank" as well as the sensible housewife, and one of the former will cause you more trouble than a score of the latter.

Let us take a cooker more or less in detail and deal with points as they arise.

The finish should be attractive so far as this is compatible with reasonable cost and enduring qualities. Present practice is to use coloured enamel, wherever possible. On the hob-plate and any removable parts this is now wise, though it is only within the last year or so that enamels which are reasonably free from chipping and scratching have been obtainable. The enamelling of the cooker body should, however, be avoided. A stoved black enamel is still the best for that part. A hob or any removable part can be taken away and re-enamelled at comparatively small cost, but not so the carcase. Moreover, the carcase is the part which is most likely to be damaged, both in transit and on the customer's premises. Nickel-plating of the hob and raised parts has a lot to be said for it, in spite of enamelling. It is a bit more costly, but it gives the cooker a bright appearance, and is easily cleaned. If this is done, however, the hob surface should be left matt and not polished bright, as it will then not show the scratches made by pots and pans. White vitreous enamelled door panels and oven sides on a stoved black cooker look very well, and are not costly to maintain.

The best oven shape depends to some extent on the size of the oven. For general hiring purposes I am convinced that the best is the "high" or gas-oven shape. Some raise objection to this because it is "following the gas people," but why did the gas people standardise it? This shape gives the greatest amount of useful shelf area, with the smallest demand on floor space. This is not so important in a floor-type cooker as in a table cooker, as in the former case the deciding factor is the area of the hob. The disposition of the heating elements is perhaps the point of greatest controversy about an oven. For a high oven, side heating is correct, but some attention must be given to the actual location of the heaters, otherwise even distribution of heat may not be obtained. There is at least one oven on the market which would be quite good were the position of its elements altered, but which at present is associated with uneven heating. For an oven of the wide or coal-oven shape, side heating with some bottom heat is correct. One disadvantage is that the introduction of bottom heat increases the cost of construction. Ovens of this shape are, however, more popular at the moment than high ovens, but sooner or later there will be a reversion to the high one. Probably the chief reason for their present popularity is that they look bigger, but experience soon proves otherwise. Pull-out interiors are popular, but they will not remain so. Such an oven is slower than one with a fixed interior, unless its loading is increased, because there is a bigger proportion of non-useful capacity; moreover, the mass of metal inside the oven is increased somewhat. To reduce this increase to a minimum there is a temptation to use a flimsy construction, which soon commences to give trouble by reason of buckling, and becomes difficult to get in and out for cleaning purposes, thus defeating its own object. Welded linings are another feature; they are good, provided two points are kept in mind: first, that provision is made to prevent buckling, either inward or outward, and, secondly, that adequate provision is made for ventilation, particularly if such operations as bread baking are to be catered for. In earlier cookers, which had either wrapped or riveted linings, moisture was able to escape through the joints, but in an oven with welded linings this is not so, and good results will not be obtained unless surplus moisture is got away. This is one of the reasons why an oven of good thermal characteristics is not necessarily a good baking oven. It it sometimes argued that a coal oven has no ventilator, but the fact is overlooked that such an oven has riveted linings, around which the flames or hot gases from the fire circulate, and that the surplus moisture is thereby drawn out and passed away to the flue. If it were not for the effect of this moisture on slag wool, which is the most widely used lagging medium, quite a lot could be said for riveted, or spot welded, linings. The enamelling of oven interiors may nowadays be regarded as safe. It is very desirable from a hygienic point of view, but while non-friable enamels were not obtainable it was not wise to go beyond the enamelling of element guards and door panels, which could be easily renewed in case of chipping taking place.

Stainless-steel is probably the ideal for the interior, but at present cost forbids its use. Chromium-plating may also offer some possibilities in the near future. Runners for shelves should be plentiful, easily cleaned, and so constructed that the shelves run freely, not only when new, but for so long as the oven shall last. One of the most frequent complaints so far as ovens are concerned is the difficulty of getting shelves in and out.

Thermometers are very debatable appliances. If they gave to the user a true indication of the air temperature inside the oven they would be a most useful adjunct; but they do not, because it is practically impossible to shield the bulb, or, in the case of a metallic indicator, the metal housing, from the element radiation. They also have a lag which cooks will not take into consideration when opening and closing the oven door. The only really useful function which a thermometer or an indicator can serve on an electric oven is to guide the cook who wishes to heat up an oven which has already been partly heated, as, for instance, raising to pastry temperature after having cooked luncheon and served it up. All other temperatures should be obtained on a time basis. In isolated cases, where there is voltage variation, this might present a little difficulty at first, but the effect of such variations, where they do exist, is not nearly so great as that of a change of wind on a gas or a coal oven. Door fastenings and hinges should be such as to ensure that the door makes a practically airtight fit on its frame. The door should not be allowed to act as a ventilator. Many a good oven is spoiled by a bad door catch. The chief duty of a catch is to keep the door properly closed, but it must also be easily opened and easily closed, otherwise it is not a good catch.

Now we come to the item which is the cause of nearly all the trouble, namely, hotplates. The shape of plates has in the past been largely determined by the ease, or otherwise, of manufacture, rather than by their relative usefulness, and rightly so, as there is not a great deal to choose in the latter direction when one takes into consideration the many sizes of pans which are used in several combinations on different days of the week in various kitchens. On the whole, observation shows that the rectangular plate presents the smallest amount of uncovered plate area, in general use, and is, therefore, all other things being equal, the best shape to use. Such a plate has the further advantage that it can be split to form two other smaller rectangular plates, to much better advantage than can a square one, though on this head it cannot claim much, if any, advantage over a round plate divided into two concentric portions. With regard to types, there are three, *viz.*, open, protected, and solid. At present the latter holds the field, but this is only a temporary phase, and the plate which comes to stay will be an open one. Probably the reason for the solid plate being in demand at present is that all the comparatively new cooker users began using cookers when badly designed open or protected plates were being used in an attempt to get away from the deadly slowness of the old solid plate with clamped sandwich elements. When they found that those plates were not perfect they turned to the newer solid plate, which, while admittedly far ahead of the old ones, still possesses the troubles which must be inherent to any such plate, which troubles are of great concern to the user.

As with ovens, so with hotplates. Their chief function is to cook, and not to give the highest possible thermal efficiency. A plate may have a high efficiency and make a good water boiler for boiling vegetables, but be an absolute failure when it comes to cooking as distinct from plain boiling.

The essentials of a plate are speed, reliability, and flexibility, and unless it has all three it is not a good plate. Open plates have the first, if properly designed, and the third. Solid plates of modern design have the second, but not the first and third. Protected plates have all three, in varying degrees, according to design, and are therefore the correct type, or rather the best proposition at the present time, notwithstanding the apparent popularity of the solid type. For long-period duty, such as is met with in cafés and canteens, the solid type is probably best at present, but for the domestic cooker its slowness in heating up from cold, and its heat capacity when hot, make it unsuitable. A further disadvantage is that flat-bottomed pans are almost essential, and these are a costly item for the consumer to provide. In their endeavours to get speed, manufacturers have, in some instances, entirely overlooked the duties which a hotplate has to perform. It is absolutely useless to crowd a high loading into a confined area. The plate itself may stand up to it, but it will be the ruination of any substance on the plate containing carbonaceous matter, by burning it. There is a limit to the amount of heat which can be absorbed by any substance, per unit of area exposed to heat, and it is useless to go beyond that limit.

The problem is to increase the area of application, and not the intensity. The use of pans with flat bottoms is one way of doing this, so far as solid plates are concerned, and in modern solid plates further assistance is given by reason of the fact that the element is distributed over a much greater portion of the area of the plate than was the case in the older type of plate in which the actual element area was only about half the plate area. The ideal to aim at is to absorb, in the most even manner, by the body of the vessel containing the matter to be heated or boiled, the whole of the heat dissipated by the plate. This may at some time be possible by induction, but the only feasible way at present is by radiation, and it is therefore the open-type plate which should be developed. A cooker recently introduced in America has this principle, though it remains to be seen whether or not it is correctly applied. A somewhat similar plate has also been on the English market for some time, but in both cases the type of element used and the manner of fixing do not appear to be correct.

Until some material other than nichrome is produced from which to make up the elements, the definitely open type of plate will not arrive. A properly designed protected-type plate will protect the nichrome from the ill-effects of a "boil over," but it will not stop oxidation. To afford this protection, however, it is necessary to remove the element from its desired proximity to the utensil, and so reduce both speed and efficiency. Careful design and the choice of a correct means of protection can, however, result in the production of a plate which is as efficient as an open plate (in the present stage of its development) with the added advantage of the reliability of a solid plate, and the further advantage that in the case of a fault only part of the plate need be replaced, whereas with a solid plate the whole would need to be changed.

With grills, again there is a demand for speed at present, but those who ask for it do not know what is really meant by grilling. It might be defined as the application of radiant heat of certain temperature (or intensity) for a definite period, according to thickness of the object to be grilled. If more or less time is taken the food is not properly grilled. The aim when designing a grill, therefore, should be to see that the applied heat is such that a steak or chop, or whatever it may be, is correctly grilled when subjected to that heat for the correct time. Go into a good grill room and tell the chef that you want a grilled steak in five minutes; your ears would not get grilled, but they would be burned by his remarks, and so would the steak, *if* he did it. There is a tendency at present to load grills up and to supply three-heat regulation. There is no objection to the latter, apart from extra cost, and it has a distinct advantage when the grill is also used for warming the hot cupboard. One way in which grills might be improved would be by making them of a greater area. There is difficulty, of course, in doing this without increasing the area of the hob, and consequently of the floor space required, but it is worth bearing in mind.

Much more might be said about cooker assembly, position of fuses, switches, hotplates, hot cupboard, and methods of wiring. The object of the article, however, is to deal with the application of heat in the essential parts of the cooker, so as to obtain good results from the users' point of view, rather than from a purely engineering standpoint.

Railway Claims.

Some Notes on Compensation for Loss or Damage.

By J. W. PARKER, A.M.Inst.T.

CLAIMS against railways arise under two separate headings: in the first place, there is the matter of legal "damages" in connection with questions of individual rights in property, &c., and secondly, there is the more common procedure arising from breakages or loss of goods handed to the companies for safe transit. In the ordinary way railways are insurers of the safe arrival of goods; consequently any substantial failure to carry out the spirit of their guarantee has to be met with monetary compensation. Unfortunately for the trader, however, the procedure is so hedged around with regulations and customs that unless considerable care is exercised compensation is lost because one has failed to comply with some requirement.

The "out-of-date" claim is a case in point. Nearly everyone has fallen foul of this proviso at one time or another and has in consequence been unable to secure satisfaction. Next to lack of knowledge, misconception is probably the most prolific cause of trouble, many business people having the erroneous belief that only the party paying the carriage is entitled to make a claim. There is no rule on this point recognised by the railways, and it will be found that they will negotiate with either party, their only concern being to avoid paying the same demand twice. If both parties lodge a claim, the railways will secure the withdrawal of one before proceeding to negotiate with the other claimant. They will, however, verify for themselves whether the carriage has been paid and, if not, will refuse to allow the equivalent sum in the compensation amount. As to which party ought to put in the claim depends upon several things. There is much to be said for the bigger firm undertaking the duty, as it is clearly better able to do this than a small retailer. Not only is it more likely to have the specialised knowledge and organisation at its command, but its very size gives a greater influence and bargaining ability than the small firm can possibly possess. Moreover, the preferment of claims in a large organisation can for the most part be resolved into a smooth running routine needing a minimum of supervision.

In the case of special and technical products like electrical machinery, it is generally better to leave claims negotiations in the hands of the senders as they know the characteristics of their own products better than anyone else. Thus when any dispute arises the sender has the facts before him. It should, however, be borne in mind that all the larger companies have extensive works of their own, and consequently a staff of electrical engineers competent to express opinions from the transport standpoint. Questions of doubt are usually referred to a Railway Clearing House Committee consisting of these experts, and they are the deciding factor. At one time the railways were wont to use generous claims settlements as part of their inter-line competition and make a good allowance for damaged goods or salvage as a means of securing traffic from a competing railway, but to-day this is no longer possible, all demands involving more than one company being settled by all railways in conference through the medium of the Clearing House Joint Claims Committee.

Since the enforcement of the standard conditions of carriage referred to in a previous article, the lot of the trader in respect of claims has improved in one respect. He is now allowed seven days for making the written claim as against three previously, providing notice is given in writing within three days. Despite this, a large number of otherwise sound demands continue to be rejected through the laxity of the consignee, and unfortunately the loss falls not on the receiver but on the sender, who is almost invariably innocent. The only complete remedy for this appears to be an educational campaign within the industry. In those cases where damage cannot be accurately ascertained until repairs have been executed, the position can always be covered either by a " claim anticipated " statement, which is a claim without amount, or by making a rough estimate which is to be corrected later. Allied with this question is the matter of salvage inspection and disposal.

In all cases of damage, derangement, or breakage, the railways should be asked to inspect the remains of the consignment before they are disturbed. Failure to observe this precaution is likely to lead to complications and delay when the time for settlement arrives, as no railway likes to pay a claim until satisfied as to the salvage. Up to three years ago dissatisfaction existed in some quarters owing to the arbitrary way in which the railways dealt with claims on goods carted by the traders themselves. They argued that they had not the handling and complete control of the traffic throughout the transit when the trader performed collection or delivery, and they insisted on making a percentage cut on all claims arising under these circumstances. This amount varied in different localities and between various trades so that industry as a whole did not know the exact position. The matter was taken up as a national question with the result that a uniform percentage was agreed between the parties.

The amount of time and clerical work involved in making claims for small amounts has been found by experience not to be worth the trouble taken, hence the majority of large firms come to an understanding whereby demands for amounts not exceeding 1s. 6d. or 2s. are automatically cancelled, and in return, larger amounts are met in full. Whilst it must be conceded that a considerable amount of time is necessary to investigate claims, it should be kept in mind that it is the trader who is standing out of his money during the inquiry, and the interval between lodging a demand and receiving payment should not be too long. Some recording method should be introduced whereby a trader can watch the progress of his claims and issue reminders in cases of delay.

A widespread impression exists that claims cannot be established on goods consigned at owner's risk, but this is only partly right. Whilst it is difficult to secure compensation, circumstances do arise under which a demand can be successfully made. Broadly speaking, it is necessary to prove wilful misconduct on the part of the railways, which is not easy, if only from the fact that nearly all useful evidence is in the hands of the defending party—the railway itself. It is true one can go to law and compel the production of witnesses, but as a practical remedy it is as cumbrous as it is unsatisfactory. Much better is it to rely upon the doctrine of *res ipsa loquitur* —the thing speaks for itself. If, for example, electrical goods at owner's risk pass from " B " to " C " regularly without damage, but on one occasion a consignment packed, handled, and loaded in precisely the same manner as the previous half-dozen is found to be badly smashed, a clear presumption of wilful misconduct arises which should be pressed home. The occasions when this can be proved will doubtless not be frequent; hence, three further exceptions under which it is possible to make a sound claim will be welcome. The first one is non-delivery of a properly addressed and packed consignment, unless the failure can be proved to be due to train accidents or fire. Secondly, pilferage is a good ground for making a claim provided the goods concerned are protected by packing more adequate than paper or other easily removed covering. In the third place, misdelivery will be recognised where goods are not tendered within 28 days. In any of these instances, however, the railways have a loophole if they can prove that they have not been negligent. Although the provisos and exceptions make owner's risk matters somewhat complicated, there are distinct opportunities of securing redress, given a little application of the rules.

There is one point regarding claims which makes common appeal to all interested parties, and that is prevention. Senders, railways, and consignees all incur loss of some kind when damage, breakage, &c., occur, as the sender has the trouble of duplicating the order, the consignee suffers delay and possibly loss of trade, and upon the railway falls the duty of reimbursing one of the parties. Recognition of this unpleasant fact has caused a certain amount of joint effort in the past towards eliminating the cause of loss. Much still remains to be done by co-operation in the way of improved packing, labelling, stowing, loading, and other handling and transport problems, and only by a closer joint examination of the issues can the needless economic waste be reduced and ultimately eliminated.

Wiring Rules in Australia.

THE work of revising and promulgating the electrical wiring rules originally prepared by the Institution of Engineers, Australia, has now been taken over by the Standards Association of Australia and committees in each State have been formed, being mainly the same as those originally appointed by the Institution. The Sectional Committee of the Standards Association controlling the sub-committees, which has been in conference in Sydney recently under the chairmanship of Sir George Julius, B.Sc., is composed, amongst others, of representatives of the electricity supply authorities, Fire and Accident Underwriters' Council of Australia, contractors' supply houses, and the Institution of Engineers, Australia, and is thoroughly federal in character. The Committee considered an analysis and review of regulations existing in all countries, which had been drafted and submitted to each State sub-committee for comment, and decided upon a scheme of procedure that provides for a complete revision and re-arrangement of the present rules. New rules are to be added to cover more fully the growing demands of radio installations, neon signs, and welding and X-ray apparatus. To take care of revision and interpretations, a Federal Executive Committee, with representatives in each State, has been appointed. The Committee, which will work in conjunction with the State sub-committees, has decided to proceed immediately with the revision of that portion of the rules covering low- and medium-pressure installations, mining accessories, and apparatus. The main object of the re-organisation is to secure a code of rules applicable to the whole of Australia.

Fuel Physics.

Problems which are not capable of chemical solution.

A LECTURE on "Physics in Relation to the Utilisation of Fuel" was recently delivered, under the auspices of the Institute of Physics, by Dr. C. H. Lander, C.B.E., Director of Fuel Research, who said that in every stage from the getting of coal to the efficient utilisation of its heat of combustion, physical as well as chemical considerations were of the greatest significance.

Coal was commonly classified upon considerations of its volatile content, flaming characteristics, or ultimate chemical analysis, but scientific workers were gradually realising the important bearing of the actual nature of the coal substance, including its physical structure, upon fuel problems. The aid of the microscope, for instance, had recently been widely enlisted for the examination and classification of coal, and the identification and co-relation of coal seams. Two methods were now commonly employed: either a thin section might be prepared for examination by transmitted light, or a surface of the specimen might be polished, and, if necessary, etched for examination by reflected light.

The application of X-rays to the examination of the ash of coal had recently been developed in this country, and was yielding useful results, the method depending upon the difference in transparency to X-rays of the organic coal substance and the inorganic ash constituents. From the results so far obtained, it seemed probable that improved technique would render the method a rapid means of determining the distribution, nature, and amount of the ash in coal, which had an important bearing upon problems of coal washing.

Attempts had also been made to gain further information of the structure of coal and coke by means of an X-ray spectrometer. This work apparently demonstrated the presence of graphite in each of the types of coke examined; moreover, when four widely different varieties of coke were investigated, distinct parallelism was observed between the size of the graphite crystals, as indicated by the shapes of the resultant reflection curves, and the reactivity of the coke, as determined by the Fuel Research Station method, the most reactive coke apparently being made up of the smallest crystals, and *vice versa*.

This method was an interesting illustration of a physical method of attack proving of assistance in unravelling problems which, so far, had not proved capable of a satisfactory solution on purely chemical lines. The best and most accessible seams having been worked first, the necessity for the more general adoption of coal-cleaning operations had in recent years become apparent.

All commercial coal-cleaning processes depended upon differences in the physical properties of the impurities and of the coal itself, but some of the mechanical principles underlying coal-washing plant were by no means completely understood.

Complete and efficient combustion involved considerations of both chemical and physical natures. A considerable amount of attention has been given during recent years to the design of burners and combustion chambers for pulverised fuel, but uncontrolled turbulent motion did not represent a completely satisfying solution of the problem of securing rapid relative motion of the coal particles and air. It appeared that what was needed in practice was to obtain stable and streamline motion of air, and to induce the particles of combustion to move from one streamline to another in as controlled a manner as was possible. The primary combustion air might, for instance, be arranged to form a vortex, with air entering at the perimeter and leaving axially, the powdered fuel being injected into the vortex at any convenient point, or points. The particles of fuel, in addition to being carried round with the moving air, would tend to move radially across the streamline under the combined action of centrifugal force and the inward pressure gradient due to the radial distribution of the velocity in the vortex; such radial motion would be opposed by ordinary frictional air resistance, the air possessing a steady inward radial component of flow owing to the inflow at the perimeter and outflow at the axis of the vortex. In that way the particles would be scrubbed by a continually changing atmosphere, and it might be possible to cause them to remain suspended in the vortex for the short length of time necessary for the complete combustion of the solid fuel under those conditions.

A Church-lighting Scheme.

The installation at the Dutch Reformed Church at Wellington, S.A., has some distinctive features.

WHAT is claimed to be the finest illuminated church in the Cape Province of South Africa is the Dutch Reformed Church of Wellington, which enjoys great renown owing to the fact that the distinguished preacher, Dr. Andrew Murray, used to occupy its pulpit. The interior, according to Mr. F. G. H. Louw, the architect, is described as "Classic Dutch," which, it will be noted, is designed without wealth of embellishment, the building being lofty, well ventilated, well lighted, and devoid of the usual architectural features common to places of worship. It excels, however, in its architectural lighting, which was installed by Mr. C. I. Evans, of Wellington. For this installation the whole of the wiring, cable, conduit tubing, switches, distribution boards, and lighting fittings were supplied by the British General Electric Co., Ltd. Gasfilled lamps are used exclusively, those in the main centre "Unalux" fitting, which is 24 in. in diameter, being of 500 watts in the centre bowl, surrounded by 100-watt lamps in the spherical "Equiluxo" bracket arm fittings projecting from the corona band. The remaining "Unalux" pendant units, which are 18 in. in diameter, are equipped with 300-watt lamps, while the 10-in. under-gallery fittings of similar pattern are equipped with 100-watt lamps. The organ lighting is contrived by a flexible standard with nickel-plated reflectors. The top of the church and the clock tower are illuminated very effectively by "Gecoray" silvered-glass lighting reflectors, which render the church visible at night from a considerable distance.

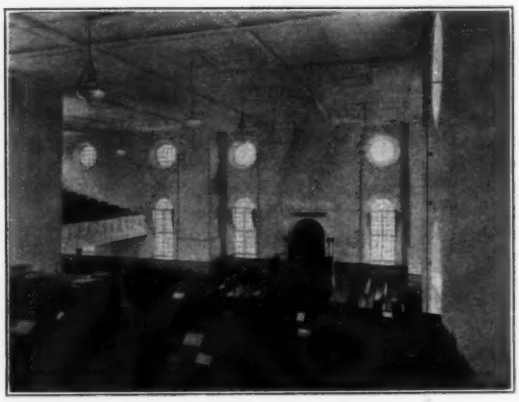


Fig. 1.—Daylight View in the Church.

Fig. 2.—The Church Interior by Night.

One very remarkable characteristic of the illumination of this church—the intensity of which at pew level is of the order of nine foot-candles—is the very close approximation to actual daylight obtained from the lighting installation. Fig. 1 shows the lighting by African mid-day sunshine, while fig. 2 is an untouched night view of the interior by artificial lighting. As an example of enterprising overseas church lighting, this church can have few equals, and great credit redounds to all those concerned in the designing and carrying out of so praiseworthy an installation.

Electricity in Empire Coal Mines.

The British Empire Steel Corporation is making good headway with its programme for the substitution of electricity for steam in the operation of its coal mines. Its power plant on the southern side of Sydney Harbour has now been linked up with its Sydney steel plant, and a high-voltage line is being run in a submarine cable under and across the entrance to Sydney Harbour to connect the workings at Sydney mines with the power plant. At number IB. Colliery a large compressor, said to be the most modern of its kind, is to be installed.

Parliamentary News.

[By Our Special Parliamentary Reporter.]

The Coal Mines Bill.

On December 19th, by 281 votes to 273, the House of Commons gave a second reading to the Coal Mines Bill. The debate on the measure lasted two days, and the Bill was very severely criticised. Many members considered that it would lead to dearer coal, especially for gas and electricity undertakings. Sir HERBERT SAMUEL, who was chairman of the 1925-26 Coal Commission, said that while the Minister of Transport during the previous week had rejected the policy of high prices, quick profits, and a quiet life with regard to electricity, his colleague, the President of the Board of Trade, in relation to the mining industry, was offering to the coal-owners that very policy.

The Government indicated, however, that it would consider amending the Bill in Committee.

Brookman's Park.

On December 17th, Sir WILLIAM MITCHELL-THOMSON asked the Postmaster-General if he would state what call-sign was being allocated to the second station at Brookman's Park; and when it was anticipated that a full alternative programme would be transmitted from that station.

Mr. LEES-SMITH said that it had been agreed that, for the time being, the London call sign "2LO," should cover both transmitters at the Brookman's Park station. When two programmes were transmitted simultaneously they would be referred to as "London Regional" and "London National," respectively. The tests which were now being carried out in the transmission of alternative programmes for short periods would be continued for some weeks; but the British Broadcasting Corporation was not yet able to state the date on which it expected to be in a position to transmit full alternative programmes from the station.

Overhead Telephone Wires.

On December 17th, Lieut.-Col. AINSWORTH asked the Postmaster-General if he would state in how many districts during the current year new poles and overhead wires had been erected in connection with telephone development work; in how many instances protests had been made against their erection by the local authorities concerned, on the grounds that they created a nuisance or detracted from the amenities of the district; on what conditions those protests were acceded to; and why, in view of the fact that it was the ultimate aim of his department to have all telephone wires underground, it was decided to erect them overhead in the first instance.

Mr. LEES-SMITH said that overhead lines had probably been constructed in practically all districts during the current year in connection with the development of local telephone services; a number of local authorities had made objections, on various grounds, but it was not possible, without a disproportionate expenditure of time and trouble, to furnish precise figures on either point. Underground cables were laid to the fullest possible extent consistent with economy, but a proportion of overhead wires was essential to the widespread development of the service unless altogether prohibitive expenditure was to be incurred.

Wireless Receiving Licences.

On December 17th, Mr. BENSON asked the Postmaster-General if he would state the cost of issuing a wireless receiving licence, and upon what basis the cost was calculated.

Mr. LEES-SMITH said that the average cost during the last financial year was about 1s. 1d. per licence. This cost was based upon returns of the time occupied, and it included provision not only for the issuing, recording, and renewing of annual licences, but also for headquarters work and for such duties as the detection of unlicensed stations and any subsequent legal proceedings.

The Channel Tunnel.

On December 17th, Mr. THOMAS, the Lord Privy Seal, informed Mr. Louis Smith that the Channel Tunnel Committee hoped to submit its report by the time that Parliament reassembled after the recess. There would be no delay on the part of the Government in considering the report. Additional facilities and technical assistance had already been placed at the disposal of the Committee.

L.N.E.R. Electrification.

On December 18th, Mr. EDE asked the Minister of Transport whether the London and North-Eastern Railway Company contemplated any extension of the electrification of its system to any of the lines in the county of Durham; and, if so, the mileage it was proposed to electrify and the towns that would be served by the electrified lines.

Mr. H. MORRISON said he was informed by the Railway Company that no electrification of its lines in the county of Durham was at present contemplated.

Special Orders.

Special Orders have been approved authorising the Farnham Gas & Electricity Company to raise additional capital for electricity purposes, and in respect of part of the rural district of Godstone, in the county of Surrey.

Cornish Electrical Development.

Some notes on an extensive overhead-line transmission and distribution system.

"Recent Electrical Development in the West" was the subject of a paper recently read by Mr. L. A. Hards, manager of the Cornwall Electric Power Company, before the Cornish Institute of Engineers at Camborne. He said that during the last two years his company's system of mains had been considerably increased. In west Cornwall alone no fewer than 33 towns and villages were supplied with electricity. A number had adopted electric street lighting, and there was a likelihood of a considerable extension in that direction. In addition, they now controlled supplies to a number of towns and villages in eastern Cornwall, including Saltash, Torpoint, Looe, Bodmin, Padstow, and Wadebridge; eventually the local plant at all those places would be shut down and they would be connected to a system of mains which would extend from one end of Cornwall to the other. It had been no easy matter to supply such a sparsely-populated area as Cornwall, and, though the cost of production was small, the cost of distribution was considerable for small quantities. They had, therefore, to keep the cost of distribution as low as possible, and the principal way of doing so was by the use of overhead mains. There had been great antagonism to that, which had tended to seriously impede the extension of the supply. On the one hand, engineers were doing their best to give the service which appeared to be required, and, on the other hand, the general public was doing its best to prevent them. When their early mains from Hayle to Carn Brea were constructed, they had to be considerably deviated and the line to the west, to Geevor and Botallack, had to go over the moors; had that not been the case they would have been supplying all the villages between Carn Brea and Penzance by this time. To supply them now would mean the construction of more mains. It was difficult to say what the future would be for them, but in the meantime they were doing their best to serve the area in the most economical way possible, by the use of the cheapest methods of transmission and local sub-stations. Electrical engineers certainly did not put up overhead mains for preference; they caused a good deal of trouble and were far more difficult to install. They had various authorities with whom they had to deal, and it was important that they should not interfere more than was absolutely necessary with the telegraph and Post Office services. It took far more time and trouble to lay out a system of mains overhead in a town or village than it did to lay mains underground. Unfortunately, the initial cost was so enormously greater in the case of underground mains that overhead mains were the only practicable method of providing supplies in scattered areas. Again, the service with an underground main was more reliable than it was with overhead wires. Quite recently Cornwall had suffered from some of the worst storms in their recollection; the velocity of the wind at Falmouth during the night of November 6th was 103 miles per hour, while at the Scillies the indicating needle went off the scale at 108 miles per hour, and from calculation they arrived at the figure of 112 miles per hour. During those storms a considerable amount of damage was done to their overhead system; it was, however, generally of a minor character, such as small displacements of the wires, the principal trouble being due to falling trees, but no poles carrying high-pressure wires were brought down. The staff had a very strenuous time, but the public suffered very little indeed in the way of loss of service. He, personally, expressed his appreciation of the way in which the Cornwall Electric Power Company's overhead lines staff stuck to duty during the very severe weather. The public was not generally in a position to know what that sort of work entailed.

Diesel Engine Users' Association.

A good number of members and visitors attended the December meeting of the Association to hear a paper on "A Form of Coupling for Geared Diesel Engines for Land and Marine Purposes," by Mr. W. Brose. The form of coupling described was developed in the Vulcan Yard, Hamburg, and is based on the patents of Dr. Bauer. It is claimed that it minimises torque fluctuations and permits splitting up the power of one large unit into two or more high-speed light units, whose small cylinders are much less sensitive to heat stresses. The device consists of hydraulic couplings with mechanical gearing, or of two wheels of cup-like section, one driving the other. The driving fluid is held in the cups of the wheels. There is no metallic connection between the wheels, and it is not essential for them to be exactly in line. The transmission of power is effected by the rotation of the driving wheel, which sets up a circulatory motion in the fluid between the two cups and thus sets the driven wheel in motion.

The driving efficiency is given as 97 per cent., and the coupling has the advantage of mechanical simplicity. The paper concluded with a description of specially designed gears for electric power stations, particularly for peak-load generators.

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Business and Industrial Notes.

The Week's Electrical Trade News from all Sources. Commercial and Industrial Developments, Business Changes, Market Prices for Materials, Trade Openings, New Publicity Literature, Liquidations, and Failures.

The "Electrical Review" Index.

The index to Vol. CV (for the half year ending December 31st, 1929) will be published shortly, and we shall be glad to receive the names and addresses of those who require it (free of charge) for binding purposes or wish to retain it for reference. Application should be made as early as possible to the Publisher, 4, Ludgate Hill, E.C.

E.D.A. Salesmanship Conference.

At the second of the series of E.D.A. Salesmanship Conferences held at the Manchester Lighting Service Bureau, Mr. R. C. Hawkins, the district officer, gave an interesting paper on the "Value of Exhibitions to the Electrical Industry," the chair being occupied by Mr. Romero, Salford City electrical engineer. Mr. Hawkins said that one of the day-to-day problems of electrical salesmanship was the question "Are exhibitions worth while?" Of the various types of exhibitions he proposed to deal mainly with the Ideal Home type, the general trade type, usually promoted by Chambers of Commerce, and local electrical exhibitions, usually organised by supply undertakings with the help of contractors. In the Ideal Home type they had a valuable means of publicity, but he warned them against the danger of filling up with "junk" and too much furniture. It was essential to have systematised propaganda. There should be a story to attract attention in every room. There was no doubt about the good resulting from the second type of exhibition, and he gave definite instances in which sales had immediately gone up. In spite of the large increase in the number of showrooms, the third type of exhibition was essential. In the small towns it was the best form of publicity. Summing up, Mr. Hawkins said that exhibitions had a special advantage over other forms of publicity, as the promoters were able to interest the Press and obtain extra publicity by that means. Local exhibitions should not be open for more than two weeks, and it was essential to have a good opening ceremony to attract the public from the beginning.

The Export Credits Guarantee Scheme.

The Committee, presided over by Sir Otto Niemeyer, G.B.E., appointed to consider generally the administration of the Export Credits Guarantee Scheme, has produced its final report. An interim report was published in April last, suggesting a form of commercial account for the Department. The final report contains the following recommendations:—(1) That the necessary legislative steps should be taken to extend to September 8th, 1934, the period during which facilities can be granted. (2) That the liquidation of the previous schemes should be transferred to another department. (3) That for the period July 1st, 1926, to March 31st 1928, and thereafter for every year ending March 31st, a commercial account on the lines recommended should be issued by the Export Credits Guarantee Department. (4) That an executive committee of three should be appointed immediately to have powers analogous to those of a board of directors, including the choice, appointment, and remuneration of staff. (5) That the Advisory Committee should continue to function generally on the lines on which it is at present assisting the Department.

United States Electrical Exports.

A further advance in exports of electrical goods and apparatus from the United States was recorded for September, the total value being $13,116,894, as compared with $7,400,973 in September, 1928. This large increase was a general one, there being only a few small decreases. The principal rises occurred in the following classes:—Radio apparatus, from $1,197,248 to $2,627,836; refrigerators up to one-ton capacity, from $467,513 to $842,359; telephone apparatus, from $173,962 to $612,472; storage batteries, from $199,949 to $320,111; stationary motors from 1 to 200 h.p., from $210,993 to $381,378; fractional h.p. motors, from $184,266 to $279,609; d.c. generators, from $57,474 to $155,018; a.c. generators, from $12,576 to $164,845; and bare copper wire, from $92,337 to $348,687. The United Kingdom was the greatest purchaser of the last class of goods, its share amounting to $113,544. Altogether the United Kingdom imported United States electrical goods valued at $813,537 (an increase of $531,311) during September. The bulk of the shipments included fractional h.p. motors, portable electric tools, accessories and parts for motors, radio components and loud speakers, bare and insulated copper wire and cable, refrigerators and other motor-driven household appliances. Canada's share of the trade was valued at $4,106,578. Other important customers were:—Australia ($746,531), Argentina ($633,512), Mexico ($608,274), Chile ($499,375) and Brazil ($482,697). America's electrical imports during September had a value of only $232,302.

International Combustion Engineering Corporation.

Press reports from New York state that on the petition of the Bethlehem Steel Corporation, the Courts appointed a temporary receiver for the International Combustion Engineering Corporation on December 19th. Though this had been expected for some time in well-informed quarters, the stock fell on that day from 10⅞ to 6, and the whole of the stock market was shaken. The *Financial Times* correspondent says that the stock advanced last year from 45½ to 80 and to 103¾ in February this year, despite the fact that only 75 cents a share was earned last year over and above the $2 dividend. The writer says: "The idea of using waste pulverised coal for fuel was a good one, but the company was over-capitalised, over-extended, and over-manipulated in the stock market." The *Central News* quotes the president of the company as stating that a prompt reorganisation will be effected, thus preserving the value of the properties and goodwill and earning power of the company. The *Financial Times* says that the company controls, directly or indirectly, 29 domestic and foreign subsidiaries, including, in England, the Underfeed Stoker Co. and International Combustion, Ltd. The New York correspondent of *The Times* reports that receivers in equity have also been appointed for two American subsidiaries—the Combustion Engineering Corporation, New York, and the International Combustion Tar & Chemical Corporation, Illinois.

Italian Foreign Electrical Trade.

The appended table shows the Italian imports and exports of electrical machinery and apparatus during the first nine months of the current year, as compared with the corresponding period of 1928. The values have been converted to sterling at an exchange rate of 93 lire to the £. It will be seen that both imports and exports show an increase, the former of £423,430 and the latter of £167,020.

	Imports. Janry. to Septr.		Exports. Janry. to Septr.	
	1928	1928	1928	1928
	£	£	£	£
Accumulators & parts	23,000	47,660	31,190	14,330
Incandescent lamp bulbs	24,340	37,180	—	30
Electrical measuring instruments ...	28,060	45,880	690	2,010
Electrical apparatus miscellaneous ...	600,100	583,480	79,370	108,030
Telegraph, telephone and radio apparatus	659,790	1,072,020	79,970	20,130
Electric furnace and other carbons ...	110,250	132,580	4,040	3,240
Insulated cables ...	27,700	16,420	136,670	158,620
Generators "without collectors"	178,020	169,400	11,290	30,990
Generators "with collectors"	179,330	214,290	171,760	255,500
Glass and porcelain insulators	22,640	19,400	10,800	13,290
Arc lamps	430	480	—	150
Incandescent lamps ...	312,410	252,060	48,490	71,940
Static transformers ...	42,930	64,560	6,770	13,140
Insulating tubes ...	1,870	4,270	2,310	1,590
Electricity meters ...	94,090	72,330	1,950	3,340
Insulated wire	25,320	21,700	38,150	44,140
Totals	£2,330,280	£2,753,710	£563,450	£730,470

Automobile Accessories for Australia.

The Senior Trade Commissioner in Australia (Mr. R. W. Dalton, C.M.G.) reports that a new company is in process of formation for the construction of motor cars in Australia, and is desirous of receiving quotations for motor-car engines, instruments, electrical equipment, &c. Firms desirous of offering components or equipment of British manufacture can obtain further particulars on application to the Department of Overseas Trade, 35, Old Queen Street, S.W.1. (Reference No. A.X. 8921.)

New Municipal Showrooms and Offices.

The Heston and Isleworth Urban District Council has taken a further step to promote the domestic use of electricity, by erecting new showrooms and offices which were inaugurated on December 18th by Sir John Ferguson, M.P. The building occupies a site with two frontages, one to the Staines Road, and the other to the Bath Road, each having a width of 40 ft., providing excellent facilities for the display of apparatus. The ground floor includes a spacious showroom and offices. The design of the showroom and colour scheme have been arranged so as not to detract from the appearance of the exhibits, and the fittings have also been designed to conform with the general scheme, the show cases being equipped with concealed lighting. The first floor includes a general office, private offices, and drawing office, and two large rooms allocated and fitted up for meter testing and repairs. The entrance portal of the showroom, together with the display windows on either side, is carried out entirely in bronze, toned to a special tint to harmonise with the general internal effect. The building is electrically heated throughout. At the opening ceremony Mr. H. J. Nias, in introducing Sir John Ferguson, said that during the past five years rapid progress had been made, and the number of consumers had increased by 6,000, to over 9,000. The showrooms were not intended to compete with local contractors, but to serve as an advertisement of the electricity undertaking. The General Electric Co., Ltd., assisted the Council in arranging the display of apparatus for the opening ceremony.

Unemployment.

The number of registered unemployed increased by 6,570 during the week ended December 9th. At that date the total was 1,309,500, as compared with 1,302,930 on December 2nd, and 1,320,912 on December 10th, 1928.

Employment in November.

During November, reports the *Ministry of Labour Gazette*, employment in the engineering industry was still slack and, taken as a whole, showed no change as compared with the preceding month. In electrical engineering the employment continued fairly good. The number of unemployed in the engineering industry rose from 90,536 in October to 90,594, the proportion remaining at 9.0 per cent. In the electrical branch there was a rise from 3,462 to 3,583 in the number of unemployed, *i.e.*, from 4.1 to 4.2 per cent. The electric cable, wire, and lamp manufacturing group reported increased unemployment, the number rising from 3,791 to 4,214 (from 4.0 to 4.5 per cent.). In the electrical wiring and contracting industry there was a rise in the number of unemployed from 1,047 to 1,223 (from 6.3 to 7.4 per cent.).

New Italian Companies.

Among the companies recently formed in Italy are the Società Passioni e Villa, Fabbrica Isolatori e Condensatori, Milan, capital 1,000,000 lire; La Società Elettrica Alto Sangro, Rome, capital 1,500,000 lire; and La Società Struttamenti Idroelettrici, Rome.

Czecho-Slovakian Electrical Imports.

During October last the value of electrical machinery and tools imported into Czecho-Slovakia was 30,000,000 crowns (about £180,000), bringing up the total for the first ten months to 282,000,000 crowns (£1,700,000) as compared with 195,000,000 crowns (£1,180,000) in January-October, 1928.

Proposed Greek Lamp Factory.

A report published in Amsterdam from Athens says that the Philips Glow Lamp Works proposes to establish a subsidiary company in Greece. The new company, which is to have a share capital of 10,000,000 drachmae, is to produce 5,000 lamps per day, and the factory is to be erected in the vicinity of Athens.

The Electrical Trade Protection Association.

At a meeting of Birmingham electrical manufacturers and factors called by the British Electrical Trade Protection Association on December 3rd., it was announced that local secretaries of the Association had been appointed for the Leeds, Manchester and Bristol districts and, as a result of the meeting, it was decided to appoint local secretaries in the Birmingham district. The secretaries of the Association are Messrs. McMillan & Henderson, 5, High Holborn, W.C.1, and 13, Dundas Street, Glasgow.

Radio Imports into Venezuela.

An Executive Decree annuls the law prohibiting the importation into Venezuela of radio apparatus, and hereafter permits free entry provided application is filed with the Ministerio de Fomento and special permits are obtained to cover each importation.—*Reuter's Trade Service* (Caracas).

An Electricity Committee Censured.

The New Mill (near Hudderfield) Urban District Council, on December 18th, passed a vote of censure on its own Electricity Committee for having appointed a successor to the lately-resigned electrical engineer without consulting the Council as a whole. The matter arose because the Yorkshire Electric Power Co., on learning of the resignation, made an offer to take over the local electricity undertaking. The Electricity Committee rejected the offer and appointed a new local engineer. It was resolved that the Committee should not take definite action in future without the sanction of the Council as a whole.

E.T.U. to Move to London.

It is reported that the Electrical Trades Union is preparing to transfer its headquarters from Manchester to London. Negotiations are proceeding for the acquisition of a building in the Clapham district

Esthonian Water-power Contract.

The *Financial News* reports that after negotiations lasting several years a provisional contract for the exploitation of the Narva waterfalls was signed at Reval on December 22nd between the Esthonian Ministry of Trade and an English company—the International Hydro-Electric Syndicate. The syndicate is to receive a concession for the establishment of a 50,000-kW power station, the cost of erection being estimated at 30,000,000 kroner. During the negotiations the syndicate has been competing with a German banking company and another bank in San Francisco, and against the Siemens-Schuckert Co.

A Schoolboys' Exhibition.

The Hon. Esmond Harmsworth will open on December 31st a Schoolboys' Exhibition organised by the *Daily Mail*, at the Horticultural Hall, Westminster, S.W.1. The London County Council Education Department will present a number of interesting exhibits, including working models of electric trains, &c. There will also be exhibits of model engines of both stationary and marine types, petrol or electrically driven. The exhibition will remain open until January 8th, and the tickets of admission, which take the form of a Christmas card, can be obtained from "Christmas Cards," Schoolboys' Exhibition, *Daily Mail*, Carmelite House, E.C.4, at 2s. each.

Visits of British Trade Representatives.

The Department of Overseas Trade informs us that Mr. H. O. Chalkley, C.B.E., Commercial Counsellor at the Buenos Aires Embassy, will attend at the offices of the Department from January 13th to 17th, and from February 3rd to 7th to interview manufacturers and merchants interested in the exports of British goods to Argentina. He will also visit a number of provincial industrial centres. Interviews can be arranged by, or information obtained from, the D.O.T., 35, Old Queen Street, S.W.1. (Reference 5534/1/29.)

The Department also states that Mr. H. J. Brett, C.M.G., Commercial Secretary at Shanghai, will be available at its offices from January 16th to 24th. He will also pay visits to industrial centres, and the reference which should be quoted by those desiring interviews is 2203/1/29.

The G.E.C. in 1929.

The GENERAL ELECTRIC CO., LTD., has sent us a review of its activities during the year which is now closing. This shows that the company has continued its progress in a number of diverse directions. Particular mention is made of the contracts received for the Central Electricity Board in connection with the national scheme; the large turbo-generators and other plant for the Hams Hall (Birmingham) power station; the 1,500-V equipment for the electrification of the Manchester-Altrincham line; the lighting of the Thames Embankment; and many other home contracts. Some details of important overseas contracts are included, among these being a large 11,000-V switchgear order from the Pretoria Municipality; mining electrical plant for South Africa; e.h.p. outdoor sub-station equipment for New Zealand; hydro-electric plant for Palestine; motor coach equipments for the new Buenos Aires tube railway; tramway equipments for Auckland, N.Z.; and Diesel-electric locomotives for India. Steady progress has been made in the Illuminating Engineering Department, and many notable contracts, home and overseas, have been carried out with the company's equipment. Further headway has also been made in the direction of household appliances and cookers. A list is given of large installations of "Magnet" industrial cooking and baking ovens. Reference is also made to advances in connection with electric furnaces, wires and cables, marine electrical equipment, radio sets and valves, and bakelite accessories, and the activities of the Research Laboratories at Wembley are dealt with.

Cardiff Corporation and Contractors.

The *Western Mail* reports that at last week's meeting of the Cardiff City Council, the Electricity Committee reported breaches of contract by the Glamorgan Electricity Company, in that the firm had sub-let work allotted to it under the Corporation's scheme of extensions. A trade union had lodged complaints that the fair-wages clause in the contract had been violated by the employment of non-union men at low rates. Mr. C. G. Morley New, city electrical engineer, said that contractors had been warned that sub-letting was not permissible, and the Glamorgan Electricity Company had undertaken not to do so. Further complaints had been received, however, and it was found that a number of contracts had been sub-let. A representative of the firm expressed regret, and said that his excuse for the breaches of contract was the heavy cost of canvassing for orders. The Council decided that the firm should be suspended from the contractors' list for a period of twelve months.

Australian Tariff Amendments.

The *Board of Trade Journal* for December 19th reported further alterations in the Australian Customs tariff. Among the classes of goods affected are electrical fittings, consisting wholly or partly of metal, *viz.*, switches, fuses and lightning arrestors, n.e.i.; regulating, starting, and controlling apparatus for all electrical purposes, including distribution boards and switchboards, n.e.i.; dynamo-electric machines; static transformers; rectifiers; ironclad or moulded switches and fuses; and dry batteries. In every case the alteration represents an increase in duty.

The Indian Government's Purchasing Policy.

In the new stores purchase rules based on the rupee tender system promulgated on December 14th, the Government of India explains that its policy is to make purchases of stores in such a way as to encourage the development of Indian industries to the utmost possible extent consistent with economy and efficiency. Preference will be given in the following order:—(1) To articles purchased in India in the form of raw materials or manufactured in India from Indian raw material, provided the quality is sufficiently good. (2) To articles wholly or partially manufactured in India from imported articles, provided the quality is sufficiently good. (3) To articles of foreign manufacture stocked in India, provided they are of suitable type and of the requisite quality. (4) To articles manufactured abroad which need to be specially imported. The purchasing authority when satisfied that such a measure is justified, may allow a limited degree of preference in respect of price to articles produced and manufactured in India, either wholly or partly. All articles specified, except military stores, or of a special or unusual character, shall be purchased with the condition that delivery be made in India and payment made in rupees in India. Tenders will be invited in India and also abroad when desirable, but delivery must be made in India and payment must be made in rupees.

The rules provide that technical apparatus and equipment and other stores for which drawings, patterns, specifications and designs are issued by the authorities, will be indented by the India Store Department in London unless available in India. The articles of a special or unusual character which can be purchased through the agency of the India Store Department, London, or direct from the manufacturers, include scientific instruments.

These rules come into operation on January 1st, 1931. Meanwhile, the Government directs that purchases be made in accordance with these rules whenever convenient.—*Reuter* (New Delhi).

Book Notices.

"Grit Emission and the Remedy."—A treatise on atmospheric pollution by W. A. Smith. This publication of Pneumatic Conveyance & Extraction (1929), Ltd., treats the subject in its broad sense, in a very interesting manner; it is well illustrated.

The *Mechanical World* Electrical Pocket Book, 1929. Pp. 338; fully illustrated. Manchester: Emmott & Co., Ltd. Price 1s. 6d. net. It is unnecessary to say much in introducing the new edition of this useful little pocket book. It maintains its past high standard, and a large amount of new matter is to be found in its pages, particularly relating to heavy electrical engineering.

Publications of the Association of Engineering & Shipbuilding Draughtsmen. Graphical statistics. By E. N. Digweed, Wh.Ex., G.I.Mech.E. Price 2s. net.

The *Practical Engineer* Electrical Pocket Book & Diary, 1930. London: Oxford University Press. Price 2s. 6d. or 3s. according to binding. A careful revision has been made of the contents of this valuable publication, so as to keep this new edition down to dimensions commensurable with its use as a pocket book. The section relating to lighting has been re-arranged, and the tables of Wiring Regulations of the Institution of Electrical Engineers have been transferred to the section to which they are more appropriate.

"*Journal* of the Institution of Electrical Engineers." Vol. LXVIII, December, 1929, No. 396. Also list of subscribers and donors to the Institution of Electrical Engineers' Benevolent Fund for the twelve months ended September 30th, 1929. London: E. & F. N. Spon, Ltd. Price 10s. 6d.

Social Events.

The annual supper and dance of the staff of the Lothians Electric Power Co. was held at Macvittie's Guest's Restaurant, Princes Street, Edinburgh, on December 12th. Mr. H. C. Babb, general manager, presiding. In proposing the toast of "Our Guests," Mr. Babb said that of late the company had done more advertising than in the past, which might account for the very busy time experienced during recent months. Mr. G. Seddon, general manager of Edinburgh Corporation Electricity Department, responded.

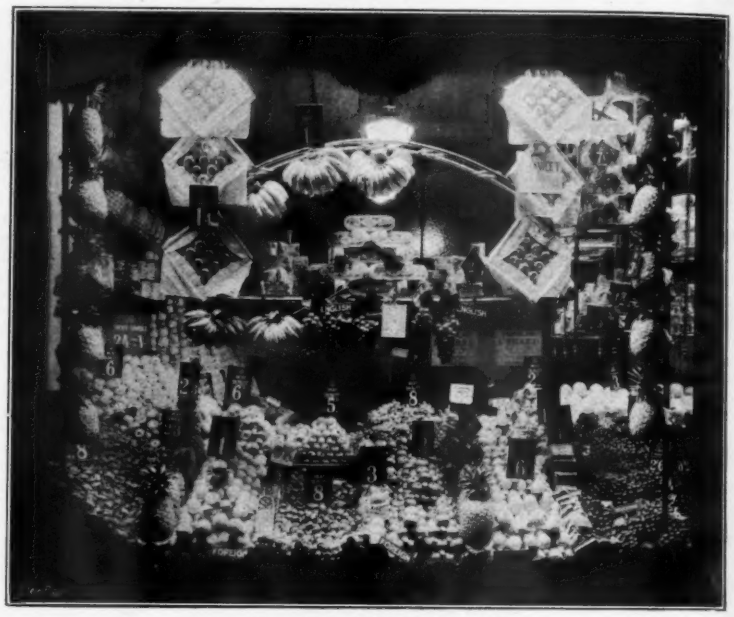
A successful dance was held at Magnet House, Kingsway, W.C.2, on November 26th under the auspices of the G.E.C. Social and Athletic Club, netball and rowing sections.

Private Arrangement.

A. B. Wakeling, 558, Beverley High Road, Hull.—Mr. W. Brian Hall, National Provincial Chambers, Silver Street, Hull, the trustee under a deed of arrangement, informs us that a first and final dividend of 3s. 9d. in the £ is being paid to unsecured creditors.

Lighting a Fruiterers' Window.

The accompanying illustration depicts an excellent example of shop-window lighting in connection with a difficult subject. The window is that of Amalgamated Fruiterers,



An Illuminated Fruit Display.

Ltd., Southampton Row, W.C.1. The equipment employed comprises G.E.C. interior and window-lighting units utilising "Gecoray" reflectors. The way in which every item in the display receives its share of the illumination is very remarkable.

The British Honduras Tariff.

The duties upon electrical apparatus other than machinery imported into British Honduras have been altered to 10 per cent. *ad valorem* under the British preferential tariff and 20 per cent. under the general tariff.

Dissolutions of Partnership.

Ashell & Co., automobile electrical engineers and Exide battery service agents, Yorkshire Street, Bacup.—Mr. H. Ashworth and Mr. T. Mitchell have dissolved partnership. Mr. Ashworth will attend to debts and continue the business under the same style.

Weir Engineering Co., general mechanical, motor boat, and electrical engineers, Hamble, Southampton.—Mr. H. L. D. Fordyce and Mr. J. R. M. Stanfield have dissolved partnership. Mr. Stanfield will attend to debts.

Bankruptcy Proceedings.

Richard Green, formerly trading as Fleet Radio Stores, 143-144, Fleet Street, E.C.—An application was made last week to Mr. Registrar Warmington at the London Bankruptcy Court for an order of discharge on behalf of this bankrupt, who failed in May, 1929. The Official Receiver reported that the provable claims amounted to £9,055; the assets had produced £5,540 and a further £4,125 was expected, making a total realisation of £9,665, from which dividends in excess of 10s. in the £ would be paid. The applicant formerly carried on business as a dealer in photographic stores; in 1922 he obtained a seven years' lease of premises at 143-144, Fleet Street, at a rental of £850 per annum, and there traded as Fleet Radio Stores. City Sale & Exchange, Ltd., was formed in November, 1923, when the bankrupt was trading at seven addresses in London, and he was appointed managing director, at a salary of £2,000 per annum. He more or less relinquished control of the business after the company was formed, and owing, as he alleged, to subsequent mis-management, the company went into voluntary liquidation in April, 1929. The debtor attributed his failure to liability under guarantees given by him on behalf of the company, and to losses owing to bad trade. His Honour granted the discharge subject to a nominal suspension of one month.

H. GASCOIGNE, 40, Cricklade Street, Cirencester, Glos., wireless dealer, &c.—The public examination herein was held on December 18th at the County Court Buildings, Swindon, when a statement of affairs was filed showing gross liabilities of £746, against assets of £138. It appeared that the debtor was out of employment for ten months after being demobilised, and he then obtained a situation but left to go into partnership. He subsequently bought his partner out, but he soon became aware that the business was not a success, and he got into financial difficulties after a three months' illness. It was reported that the debtor's books had been kept satisfactorily. The hearing was adjourned for closing.

E. W. BLAIR (Blair & Son), electrical engineer and contractor, 6, Queen's Parade, Brent Street, Hendon.—Last day for proofs for dividend, January 2nd. Trustee, Mr. T. Gourlay, Official Receiver, 29, Russell Square, W.C.

T. E. WOODHEAD, electrical factor, 26, Central Drive, Blackpool.—Last day for proofs for dividend, January 2nd. Trustee, Mr. H. Parker, Official Receiver, 9, Cannon Street, Preston.

R. R. WRIGHT (Wright Bros.), wireless dealer, 36, Normanton Road, Derby.—Last day for proofs for dividend, January 3rd. Trustee, Mr. L. A. West, Official Receiver, 22, Regent Street, Park Row, Nottingham.

F. PRICE and C. R. TARVER (F. Price, Tarver & Co.), electrical engineers, 15, Working Street, Cardiff.—First and final dividend of 1s. 6½d. in the £, payable December 24th, at the Official Receiver's office, 34, Park Place, Cardiff.

Company Liquidations.

STANDARD PLATINUM CONTACTS, LTD., 121-123, Shaftesbury Avenue, W.C.—Under a compulsory winding up order made against this company on November 18th upon a creditors' petition, the statutory first meetings of the creditors and shareholders were held on December 13th, at the Board of Trade Offices, Carey Street, W.C. Mr. Naunton, Official Receiver, reported that the company was formed as a private company on August 22nd, 1927, with a nominal capital of £5,000, to carry on business as manufacturers of platinum contacts, magneto parts and engine valves. It was promoted by C. E. Taroni, who started business in August, 1926, under the name of Standard Platinum Screw Co., at Mortimer Street, W. The concern was financed throughout by Taroni, and the trade resulted in a gross profit but a net loss. The failure was attributed to inefficient management and heavy liability of the company in connection with the lease of the premises. A statement of affairs had been lodged, showing liabilities of £2,774 and a deficiency of £5,661 with regard to contributories, the issued capital being £3,499. The liquidation was left in the hands of the Official Receiver.

NIGERIAN POWER & TIN FIELDS, LTD.—Winding up voluntarily for amalgamation purposes. Liquidator, Mr. S. Hutchinson, Finsbury Pavement House, Moorgate, E.C.2, who is authorised to enter into an arrangement with a new company to be formed for the sale to it of the undertaking and assets of the company, &c., in accordance with the terms of the scheme for amalgamation.

Trade Announcements.

The RADIO SUPPLY CO., Wood Street, Northampton, has opened a stockroom at 43, Queen Street, Peterborough.

During the greater part of last week Messrs. MARSHALL AND LUPTON, LTD., 14, Davies Street, W.1, held a special exhibition of modern electric lighting devices designed by Mr. J. B. Gold, architect.

Mr. W. D. SNAPE informs us that he has taken over the business of L. Andrew & Co., 2, Whitworth Street West, Deansgate, Manchester, and will carry it on under the same style.

The "Gleam" fuse-wire holder, a handy device designed by Mr. James Duncanson, which was described in our issue of September 10th, 1926 (p. 441), has been improved and is now marketed as the "New Series Quick Service" fuse-holder by the D. F. M. MANUFACTURING CO., LTD., 29, Waterloo Street, Glasgow, of which Mr. Duncanson is manager.

Messrs. SIEMENS BROS. & CO., LTD., have made arrangements to transfer, as from January 1st, their Pyrometer and Temperature Measurement Department to their associated company, Elliott Brothers (London), Ltd. The technical and commercial staff which has been dealing with these matters is being transferred to Lewisham, together with all stocks of apparatus, records, drawings, and patterns. Inquiries and correspondence on temperature measurement matters should be addressed to: Elliott Brothers (London), Ltd., Century Works, Lewisham, S.E.13.

The offices of the ASSOCIATED AUTOMATIC MACHINE CORPORATION, LTD., and its subsidiaries have been removed to 14, Appold Street, E.C.

Messrs. GRIFFIN, HARDING & BRYANT, LTD., electrical contractors and wireless engineers, have opened new showroom premises at 1, Park Lane, Swindon.

Messrs. HOGAN & WARDROP have removed from Golden Lane to 25, Old Street, E.C.1.

The new address of Mr. VIVIAN E. WILLIAMS is 70, Finsbury Pavement, E.C.2.

Recent Contracts.

The Hackney Electricity Committee recommends the acceptance of the tender submitted by Messrs. SIMON-CARVES, LTD., Manchester, for the additions to the boiler plant at the Millfields Road generating station. The contract comprises the installation of three water-tube boilers, each having an evaporative capacity of 125,000 to 150,000 lb. of steam per hour, travelling grate mechanical stokers, economisers, superheaters, mechanical draught plant, and an independent chimney to each boiler. The contract also includes the whole of the foundations and civil engineering work, a new steel-framed brick boiler-house capable of accommodating six of these boilers, and coal-handling and storage plant of sufficient capacity to deal with the full line of boilers. The total value of the boiler plant contract is in the neighbourhood of £250,000. The boilers will be of the Simon-Carves multiple-drum type with water-wall combustion chambers and water-cooled stoker arches, fired by travelling-grate mechanical stokers. Ashes will be removed from the boilers by sluicing to an underground pit, from which they will be transferred by electrically-operated grabs to an overhead bunker for delivery to barges. The coal-handling plant will comprise electrically-driven transporters arranged for unloading coal by means of grabs from barges, and weighing and transporting it to overhead storage bunkers in the boiler house or to a large storage yard at the rear of the station. The boiler-house bunkers will have a storage capacity of 2,000 tons of coal. A new central control room for the boiler plant, a laboratory, and mess rooms for the staff are included in the contract. The new plant forms part of a large extension which is to be carried out at the station under the national electricity scheme.

Messrs. RUSTON & HORNSBY, LTD., have recently received an order for nine "Ruston" marine auxiliary oil-engine generating sets, each of 306 kW. These will be installed (three sets per vessel) on board three motor cargo liners to be built for the New Zealand Shipping Co., Ltd. Two of the vessels will be built by Alexander Stephen & Sons, Ltd., Govan, Glasgow, and the other by Vickers-Armstrongs, Ltd., Barrow-in-Furness. Each auxiliary engine will be a five-cylinder unit working on the "Ruston" principle of airless injection and capable of developing 450 b.h.p. at 270 r.p.m., or 500 b.h.p. at 300 r.p.m. and each will drive a d.c. dynamo supplied by the GENERAL ELECTRIC CO., LTD.

The PARSONS OIL ENGINE CO., LTD., Southampton, has received an order from the Sunderland Echo Co., Ltd., for one of its new high-power generating sets for installation in the Echo Company's offices as a stand-by supply. The engine is of the company's latest pattern, having six cylinders, 7 in. bore by 8 in. stroke, and running at 1,000 r.p.m. on petrol fuel. The generator and exciter will be supplied by Messrs. J. H. HOLMES & CO., LTD., and will be capable of a continuous output of 125 kVA.

The airship "R.100," which is now undergoing its trials, has been provided with specially designed electrical cable and equipment. The complete wiring installation of the airship, including the lighting, heating, wireless cabins, and power control cars, has been carried out to suit the special conditions by Messrs. W. J. FURSE & CO., LTD. This company has also provided lightning conductors for the protection of the sheds in various parts of the world where airships of this type are to be eventually housed, including one recently erected at Karachi, India.

Calendars and Diaries.

The MULLARD WIRELESS SERVICE CO., LTD., Denmark Street, W.C.2, has again adopted a large representation of a radio valve for its calendar. This time the young lady is of a very modest type. A block of daily slips is provided.

"Appointments for 1930" is the modest title of an elaborately-produced diary received from the UNDERGROUND ELECTRIC RAILWAYS CO. OF LONDON, LTD., 55, Broadway, Westminster, S.W.1. It commemorates the centenary of the London 'bus and contains many excellent pictures of 'buses and various phases of London's transport system.

BRITISH BROWN BOVERI, LTD., London, has sent us a very handsome wall calendar comprising twelve monthly sheets each of which bears a beautiful photographic view of Swiss scenery. Several of these show railway and other work carried out by the Brown Boveri organisation.

Beautifully-coloured views of places within the company's area form the subjects of a calendar received from the NORTH METROPOLITAN ELECTRIC POWER SUPPLY CO.

From Mr. FERNAND ESPIR, 86-88, Queen Victoria Street, E.C.4, we have received a refill for a desk memoranda tablet, with dates and reminders.

A neat oxidised-silver desk device with a calendar-memoranda tablet has arrived from the SUN ELECTRICAL CO., LTD., 118-120, Charing Cross Road, W.C.2.

Messrs. J. SHAW, SON & GREENHALGH, LTD., Huddersfield, have issued a serviceable wall calendar for 1930 with bold-figure daily slips.

Large date slips are also a feature of the 1930 calendar of Messrs. H. & C. DAVIS & CO., LTD., 1, The Pavement, Clapham Common, S.W.4. A special date-marking device is provided.

The appropriate subject of a calendar received from the COMBUSTION STEAM GENERATOR, LTD., 1, Southampton Row, W.C.1, is the youthful James Watt and the historic kettle.

The 1930 calendar of Messrs. C. A. PARSONS & Co., LTD., Heaton Works, Newcastle-on-Tyne, comprises a set of large monthly cards bearing illustrations of some of the company's productions.

An Oriental beauty reclining in "The Garden of Allah" forms the subject of the illustration upon the 1930 calendar sent us by Mr. W. H. SQUIRE, 31, Sweyne Avenue, Southend-on-Sea.

Once again we have to acknowledge receipt of a copy of our welcome companion, the diary of Messrs. SIMPLEX CONDUITS, LTD., of Garrison Lane, Birmingham. For its size it gives a very generous space for engagements and memoranda.

A serviceable wall calendar with large daily slips has been sent to us by Messrs. LINDSAY & WILLIAMS, LTD., Manchester.

A very neat blotter-diary for 1930 has reached us from the ENFIELD CABLE WORKS, LTD., 296-302, High Holborn, W.C.1. There is a writing pad in the centre, and at the sides are a pocket and a diary with weekly pages. The sides fold over to enclose the pad. The company has also sent us a business-like calendar. This has monthly date sheets which display the preceding and succeeding months. An illustration of the company's "H"-type cable appears.

The calendar sent us by Mr. L. W. FOOTE, 30, Charles Street, Cardiff, is, as usual, a very attractive one. It bears a charming picture of "Cinderella" on silk, and monthly date slips.

The German SIEMENS concerns have sent us a neatly and strongly bound diary including details of the organisation and a view of Siemensstadt, Berlin. There is also a separate memoranda book.

The little brunette of the METRO-VICK SUPPLIES calendar who has cheered us during 1929, now gives place to a charming blonde at her toilette, also drawn by Mr. Bert Thomas. A "Boldefigger" daily pad is provided.

"The Secret" forms the subject of the 1930 calendar of the CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, near Manchester. This is an artistic reproduction in colour of a new "Exide" poster picture by John May.

A bold-figured daily pad in a business-like setting comes from Messrs. T. J. GRAINGER & Co., LTD., 20, Eldon Square, Newcastle-on-Tyne.

In addition to a refill for its desk calendar, BRITISH INSULATED CABLES, LTD., Prescot, Lancs., has sent us two wall callendars. These are of a novel character. In the centre are monthly date sheets, and on either side of this are slips showing the preceding and succeeding months. Similarly there are small insets giving the past, current and coming years' dates.

The 1930 calendar of Messrs. HILDICK & HILDICK, Walsall, consists of a representation of a bunch of screwed tubes bearing a pad of daily slips.

New Catalogues and Lists.

ELECTRICAL EQUIPMENT & CARBON CO., LTD., 107-109-111, New Oxford Street, W.C.1.—Price list No. M.17, giving illustrated particulars of "Elin" mercury rectifiers. Also a leaflet drawing attention to the "Mignon" electric hand drilling machine.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester.—Publication No. 7,977/7, entitled "Electrification Work for Overseas Railways," describing electric railway installations carried out by the company in Africa, America, Asia, Australia, and Europe. Some excellent illustrations are included.

VENRECO, LTD., 55, Neal Street, W.C.2.—A well-produced catalogue of stage-lighting equipment, lamp shades, fires, chandeliers, &c. Illustrated and priced.

Messrs. HEYES & Co., LTD., Water Hayes Electrical Works, Wigan.—The first number of the *Wigan Review* contains an interesting historical article on the Wigan coat of arms, and notes on some of the company's lighting fittings.

HIGGS MOTORS, Witton, Birmingham.—A stock list of the company's a.c. and d.c. motors.

BROOKHIRST SWITCHGEAR, LTD., Northgate Works, Chester.—A pamphlet containing some notes on automatic control for a.c. motors, with particular reference to the company's products.

Messrs. W. E. BEARDSALL & Co., LTD., 5, Victoria Bridge, Manchester.—Two leaflets illustrating in colour the company's lighting fittings. Dimensions and prices are included.

RUNBAKEN MOTOR & ELECTRICAL ACCESSORIES, LTD., Magneto Works, Manchester.—Catalogue for 1930 of Runbaken accessories, giving brief particulars, prices, &c. Illustrated.

GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, W.C.2.—The "Osram-G.E.C. Bulletin" for December contains a number of interesting articles on lighting installations carried out by the company, and notes on its activities.

SADIA, LTD., 22, Newman Street, W.1.—List No. H.S.2, describing Sadia automatic electric water heaters, including illustrations, dimensions, capacities, prices, &c. The cover illustration is in colour and shows a lady turning on the bath tap fed by one of the company's water heaters.

Messrs. HICK, HARGREAVES & Co., LTD., Soho Iron Works, Bolton.—A descriptive pamphlet of the company's closed-feed system.

E.D.A. Annual Meeting.

The annual meeting of the British Electrical Development Association will be held at the Savoy Hotel on Friday, March 21st, 1930.

Prices of Raw Materials.

The following prices are only general, and they may vary according to quantities and other circumstances:—

	CHEMICALS, &c.	Price Dec. 23rd.	Fortnight's inc. or dec.
a	Acid, Oxalic ... ... per lb.	5½d.	...
a	Ammoniac, Sal ... ... per ton	£60	...
a	Ammonia, Muriate (large crystal) ,,	£52	...
a	Bisulphide of Carbon ... ... ,,	...	...
a	Borax ... ... ,,	£25	...
a	Copper Sulphate ... ... ,,	£25 10s.	...
a	Potash, Chlorate ... ... per lb.	3d. to 4d.	...
a	,, Perchlorate ... ... ,,	5½d.	...
a	Shellac ... ... per cwt.	£13 10s.	...
a	Sulphur, Commercial ... ... ,,	£11	...
a	,, Roll ... ... ,,	£11	...
a	Soda, Chlorate ... ... per lb.	3d.	...
a	,, Crystals ... ... per ton	£5 to £5 5s.	...
a	Sodium Bichromate, casks ... per lb.	3⅝d.	...
	METALS, &c.		
b	Aluminium, Ingots ... ... per ton	£95 to £100	...
b	,, Wire ... ... per lb.	1/1 to 1/9	...
b	,, Sheet ... ... ,,	1/1 to 2/9	...
p	Babbitts Metal and Anti-friction Metals—		
	Grade I ... ... per ton net	£168	£3 inc.
	Grade II... ... ... ,, ,,	£118	£3 inc.
	Grade III ... ... ,, ,,	£66	...
c	Brass (rolled metal 2" to 12" basis) per lb.	10⅝d.	...
c	,, Tubes (solid drawn) ... ,,	1/0½ to 1/1	...
c	,, Wire, basis ... ... ,,	10⅝d.	...
c	Copper Tubes (solid drawn) ... ,,	1/8	...
g	,, Bars (best selected) ... per ton	£110	...
g	,, Sheet ... ... ,,	£110	...
g	,, Rod ... ... ,,	£110	...
d	,, (Electrolytic) Bars ... ,,	£24	...
d	,, ,, Sheets ... ,,	£143 10s.	...
d	,, ,, Wire Rods ,,	£90	...
d	,, ,, H.C. Wire per lb.	11¾d.	...
f	Ebonite Rod... ... ... ,,	2/3 to 2/6	...
f	,, Sheet ... ... ,,	2/3 to 2/6	...
n	German Silver Wire ... ... ,,	2/2	...
h	Gutta-percha, fine ... ... ,,	nom.	...
h	India-rubber, Para fine ... ... ,,	8½d.	½d. dec.
i	Iron, Pig (Cleveland No. 3.) ... per ton	72/6	6d. inc.
l	,, Wire, galv. No. 8. P.O. qual. ,,	£20	...
g	Lead, English pig ... ... ,,	£23 5s.	10/- inc.
g	Mercury ... ... per bot.	£23 to £23 5s.	...
e	Mica (in original cases) small ... per lb.	6d. to 8/-	...
e	,, ,, medium ,,	4/- to 8/-	...
e	,, ,, large ... ,,	10/- to 20/- & up	...
p	Phosphor Bronze, plain castings ,,	1/3½	...
p	,, ,, drawn bars & rods ,,	1/5	...
p	,, ,, rolled strip & sheet ,,	1/3½	...
p	,, ,, wire... ... ... ,,	1/6	...
o	Platinum ... ... per oz.	£13 10s.	...
d	Silicium Bronze Wire ... ... per lb.	1/3	...
r	Steel, Magnet, in bars ... ... ,,	7½d.	...
g	Tin, Block (English) ... ... per ton	£180 10s. to £181 15s.	15/- to 20/- inc.
n	,, Wire, Nos. 1 to 16 ... ... per lb.	3/5	1d. dec.

*For 1 cwt. lots. Special quotations against definite specifications.

Quotations supplied by

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakespeare.
h Edward Till & Co.
i Bolling & Lowe.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p C. Clifford & Son, Ltd.
r W. F. Dennis & Co.

Reporting on December 21st, Messrs. James Forster & Co. stated that the lead market was again very quiet last week until December 20th, when, on a sudden demand for December lead, this position rose 5s. per ton, while forward fell 1s. 3d., thus establishing a backwardation on prices of 5s. per ton. This sudden scarcity of December lead is said to be due to the fact that a steamer from Mexico with a considerable quantity of lead on board has been delayed. As the producers have reduced their stocks in this country very considerably during the last few months, and there is little other lead arriving, only a small quantity of lead is available to fill up the gap before the next arrivals. Fortunately, with the approach of the holidays, consumption is at its minimum, otherwise a very acute position might arise.

The British Industries Fair.

The *Birmingham Post* reports that at a recent meeting of the Birmingham Tame & Rea District Drainage Board, an application was received from the British Industries Fair for an extension of the area of land leased from the Board at Castle Bromwich. As the land required by the Fair authorities formed part of the playing fields area in the occupation of the Birmingham Parks Department, negotiations had taken place as to the conditions under which the land could be transferred. The Parks Committee had agreed to surrender its leasehold interest in the land (about 22¼ acres) south of the approach road from Chester Road and adjoining the Fair grounds subject to adequate compensation being paid by the Birmingham Chamber of Commerce for any loss of revenue the Committee might incur. It was decided to accede to the request made by the Chamber of Commerce for that area to be added to its existing holding.

Lighting and Power Notes.

Australia.—VICTORIA.—The revenue returns of the State Electricity Commission for the quarter ended September 30th last record a total revenue of £478,678, as compared with £412,868 in the corresponding quarter of last year. Expenditure, including interest on loans, depreciation, and contribution to sinking fund totalled £471,355, as against £404,565, leaving a net surplus of £7,323 (£8,303). The sales of electrical energy increased from 91,582,957 to 104,814,331 kWh, and the maximum supply demanded from 77,730, to 86,800 kW. There was an increase of 20 in the number of towns receiving supplies from the Commission, bringing the total to 144. The ring main for supplying energy to the north-central and north-western districts of Victoria, including Ballarat and Bendigo has now been completed as far as Castlemaine, and arrangements are being made to take over the distribution in that centre, where the local private undertaking has been acquired.

SYDNEY.—The City Electricity Department is to lay underground cables to improve the electricity supply in the eastern and northern suburbs, at a cost of £352,000. A new substation is also to be constructed in Dalley Street, and feeders provided, at a cost of £178,000.

Bedford.—LOANS.—The Corporation Electricity Committee is to apply for sanction to loans of £20,000 for house services and £15,000 for apparatus for hire.

MAINS EXTENSIONS.—The Committee is to extend mains at an estimated cost of £641.

Burnley.—EMERGENCY SUPPLY PRECAUTIONS.—The Electricity Commissioners have agreed to the linking up of Burnley with the Nelson station as an additional safeguard in case of emergency.

Bury St. Edmunds.—CHANGE-OVER.—The Town Council has decided, in order to provide labour for the unemployed, to carry out work in connection with the change-over of a section of the area from d.c. to a.c., at a cost of £4,340, including a switchboard, a 100-kW rotary convertor, and 800 yd. of service cable.

Carlisle.—MAINS EXTENSIONS.—The city electrical engineer has reported to the Electricity Committee that, in connection with the unemployment grant schemes recently sanctioned in respect of extensions to mains, besides the mains laid, or in process of being laid, in certain streets, it is proposed to carry out further extensions as part of the scheme, as early as possible, amounting to £8,123.

Chester.—CHANGE-OVER SCHEME.—The Corporation Electricity Committee recommends the changing of the system of electricity supply from d.c. to a.c. during the next three years, at an estimated expenditure of £70,000.

Continental.—GERMANY.—The power station at Golpa-Zschornewitz, near Halle, central Germany, is now claimed to be the largest station in the world which uses lignite as fuel, which position has been reached by the recent starting of two turbo-generators, each of 100,000 kVA, over twice the size of the machines in use at the Berlin Klingenberg station. The station is the property of the Electro Works Company, of Berlin, which is in State ownership, and its capacity of 440,000 kW can be augmented to 730,000 kW by direct connection with other works owned by the company. The electricity from the Golpa works is transmitted by means of 100,000-V lines to Berlin, Magdeburg, and other towns, while other customers are the Reich railways, the Bavarian nitrogen works in Piesteritz, and some works of the Dye Trust.

FRANCE.—A decree published in the *Journal Officiel* approves the convention between the French Ministry of Public Works and the Sté. Union des Producteurs d'Electricité des Pyrenées for the exploitation of hydro-electric works in connection with three waterfalls: (1) of about 450 m. on the Neste de Caillaouas, (2) of about 460 m. on the Neste de Clarabide, and (3) of about 260 m. on the Neste de Lapès, of which the total net capacity is estimated to be 26,000 kW. Among other work, the Caillaouas lake is to be transformed into a reservoir. The main object is to regulate the output of the hydro-electric stations connected with the Cie. des Chemins de Fer du Midi and belonging to the Union des Producteurs d'Electricité des Pyrenées Occidentales.

Cottingham.—INAUGURATION OF SUPPLY.—The ceremony of switching on the electricity supply for the town was performed on December 17th by Councillor Benno Pearlman, Deputy Lord Mayor of Hull and chairman of the Hull Corporation Electricity Committee.

Douglas (Isle of Man).—EXTENSION APPLICATION REFUSED.—The Manx Tynwald Court has refused the application of the Douglas Corporation for permission to extend its area of electricity supply so as to include Onchan Village and Onchan Head. The application was opposed by the Manx Electric Railway Co., Ltd., which has supplied Onchan with electricity for the past thirty years.

Dronfield.—DIRECT SUPPLY.—The Urban District Council has accepted the offer of the Sheffield Corporation to supply electricity direct to Dronfield consumers at 20 per cent. above the Sheffield prices. The Council has also decided to support the Corporation's application to take over the powers vested in the Urban District Council under the Dronfield Electricity Order, 1928.

Ilfracombe.—SPECIAL ORDER.—The Electricity Commissioners have submitted for confirmation a Special Order made by them authorising the Ilfracombe Electric Light & Power Co., Ltd., to supply electricity in part of the rural district of Barnstaple.

King's Lynn.—NEW PLANT.—The Corporation electrical engineer recently presented a report upon the position of the electricity department in regard to the demand for supplies in the near future. The report was approved, and it was resolved that application be made for sanction to the borrowing of £40,000 for the provision of a 4,000-kW turbo-alternator, and for work in connection therewith.

Llandilo.—ELECTRICITY SUPPLY.—The Rural District Council has arrived at an agreement with the Llanelly and District Electric Lighting & Traction Co., Ltd., for the supply of electricity in the parish of Llandebie at the following terms:—Lighting, 7d. per kWh; heating, 2d. per kWh; and power, a sliding rate varying from 4d. to 1d. per kWh according to the quantity consumed.

London.—STOKE NEWINGTON.—The Borough Council has received sanction to the borrowing of £7,045 for mains, and £8,235 for plant.

The Borough Council Electricity Committee recommends the laying of distributor cables, at an estimated cost of £1,517.

WANDSWORTH.—The Borough Council has approved proposals by the County of London Electric Supply Co., Ltd., for the laying of conduits in 21 thoroughfares within the borough.

WOOLWICH.—The Borough Council Electricity Committee has made the following decisions:—(*a*) That the scale of maximum demand charges be altered to provide steps of 50 watts upwards from a minimum of 200 watts, subject to restriction, and that the lowest maximum demand that can be accepted under this scale is half a watt per sq. ft. of ground floor area. (*b*) That the discount of 5 per cent. hitherto allowed on both tariff and flat rates of charges be discontinued. (*c*) That the charge for the supply of electrical energy for heating and cooking for commercial purposes, be at the rate of £4 per kW, based on 25 per cent. of the maximum demand installed, plus ½d. per kWh, net. (*d*) That a charge for the supply of electrical energy alternative to the existing rate of 2.9d. and 1.9d. per kWh to small power users, be fixed at £8 per h.p. installed, plus ½d. per kWh net.

NORTH MET. PROGRESS.—The North Metropolitan Electric Power Supply Co. announces that this year, up to December 3rd, it had, for the first time in its record, connected more than 10,000 new consumers. The total number of consumers at the date mentioned was 58,000.

ST. MARYLEBONE.—The Borough Council Electricity Supply Committee recommends the expenditure of a sum estimated at £34,915, for the provision of cables and switchgear in connection with future bulk supplies to the Hampstead Borough Council.

HAMMERSMITH.—The Borough Council Electricity Committee makes the following recommendations:—(*a*) That, as from the quarter ended September 30th last, the minimum charge of £1 per consumer per annum for the supply of electricity be abolished; (*b*) that an additional £6,000 be provided to finance the assisted wiring scheme; and (*c*) that an additional sum of £1,000 be provided for the supply of electrical apparatus for hire and hire-purchase.

Marple.—UNDERTAKING PURCHASE OFFER.—An offer has been received from the Trent Valley and High Peak Electricity Co., Ltd., to take over the Special Orders of the Marple and New Mills Urban District Councils. Should the Councils decide to operate their Orders, electricity will have to be purchased from the company, which has already received powers in connection with bulk supply. The company, which claims to be able to supply electricity at a cheaper rate than the Councils, has also made application for an Order authorising it to supply electricity in the Hayfield and Glossop rural districts.

Paignton.—EXTENSION OF SUPPLY AREA.—At a recent meeting of the Urban District Council, the clerk reported that the Brixham Gas Co. was promoting a Bill empowering the company, *inter alia*, to extend the area within which it is authorised to supply electricity, so as to include part of the urban district of Paignton at Broadsands.

Ponterwyd.—INAUGURATION OF SUPPLY.—An electricity supply installation, carried out by Mr. J. Herbert Edwards, of Gloucester, was inaugurated recently by Miss Olwen Rhys, daughter of Sir John Rhys, a resident of the district. The installation has been provided free of charge, and all profit made by installing electric light for residents and for energy used will go towards village improvements.

Price Reductions.—Reductions in the charge for electricity have been made or recommended in the following districts:—

LLANDILO.—Lighting: From 8d. to 6d. per kWh. Power: From 4d. to 3d. per kWh.

PONTEFRACT.—*Yorkshire (West Riding) Electric Tramways Co., Ltd.*—Lighting: From 7d. to 6½d. per kWh.

Ribchester.—ELECTRICITY SUPPLY.—Through the agency of Messrs. Bannister Bros., of Bee Mill, Ribchester, electricity is to be supplied to the village. The cable will be laid to the firm's mill by Preston Rural District Council, and the supply will be distributed by Messrs. Bannister.

Swansea.—MAINS EXTENSION.—The Corporation Electricity Committee is to extend mains at an estimated cost of £1,122. The Committee has also decided to change over from d.c. to

a.c. in the Wassail Square district and to install the necessary a.c. mains, at an estimated cost of £780.

UNEMPLOYMENT SCHEME.—The Corporation Electricity Committee has agreed to a recommendation of the borough electrical engineer that the following works, which in the ordinary course would not be proceeded with for a period of at least three years, be put in hand forthwith for the purpose of relieving unemployment:—Replacing the existing d.c. distributors and feeders, and the whole of the a.c. triple-concentric cables in the following areas:—Swansea west, £28,050; centre of town, £25,969; Swansea north, £6,435; and Morriston, £7,507.

Torquay.—NEW PLANT.—The Town Council is applying for sanction to a loan of £98,780 for additional generating plant at the Newton Abbot power station.

Tynemouth.—METER RENT REDUCTION.—The Corporation Electricity Committee has decided that the meter rents in respect of lighting be reduced as follows, as from the quarter ending March 31st next:—For 30 lamps, from 2s. to 1s. 6d.; for 50 lamps, from 2s. 6d. to 2s.; for 100 lamps, from 3s. to 2s. 6d.; and over 100, from 4s. 6d. to 4s.

United States.—FLOATING GENERATING STATION.—Instructions have been given to the U.S. aircraft carrier *Lexington* to act as a generating station to the town of Tacoma, on Puget Sound, in the State of Washington. According to the *Daily Mail* this use of a Navy ship is due to a long drought in the district, which has seriously diminished the water supply of Tacoma's electricity system. In dock the *Lexington* is generating electricity during 12 of the busiest hours of the day and the Navy is charging the city £9,000 as a first charge and a halfpenny per kWh. It is estimated that the ship will serve the town for at least a month.

LARGE BOILERS.—Some 90 men recently sat down to luncheon in the newest of the three boilers installed in the East River generating station of the New York Edison Company, Fourteenth Street and the East River. They are the largest boilers in the world, and the luncheon was in recognition of the men whose skill made possible the completion on schedule time of the $12,500,000 addition to the city's electricity system of 215,000 horse-power. Seated inside one of the boilers, 10 ft. above the bottom and 85 ft. below the steam drums, the platform on which they sat was 43 ft. 6 in. long, by 23 ft. 6 in. wide. Floodlight illuminated the rows of more than 3,700 tubes, whose total length is 23 miles, the 11 steam drums, the pulverised coal burners, and other equipment.

The boiler, No. 9, is the final one of three installed since June 1st to provide steam for the single-unit, single-shaft, turbo-generator of 160,000 kilowatts installed by the American General Electric Co. The three boilers were built by the Combustion Engineering Corporation. The superheat temperature is 725 deg. F., and the pressure 425 lb. per sq. in., and each boiler would require almost 1,000 tons of coal a day if operated continuously at full capacity. The condenser was manufactured by the Ingersoll-Rand Company; it has 90,000 sq. ft. of cooling surface and will condense 700 tons of steam an hour. The pumps can draw 160,000 gals. of water from the East River every minute.

Walsall.—POWER-STATION FUMES.—Following complaints by residents in Walsall concerning an alleged nuisance caused by the emission of smoke and grit from the power-station chimneys, the West Midlands Joint Electricity Authority has notified the Town Council that it proposes to spend £2,000 on plant which, it is anticipated, will abate this trouble.

Tramway and Railway Notes.

Brazil.—RAILWAY ELECTRIFICATION.—Modified plans have been prepared for an electrified single mountain line for the Sao Paulo Railway. To ascend the 800-metre elevation on a 2 per cent. grade, 40 km of track would have to be constructed, compared with 10 km. as at present, and the distance from Santos to Sao Paulo would thus be increased from 79 to 109 km. It is stated that a 3 per cent. grade would be possible with electric traction, which would reduce the mountain section to 26.6 km, and increase the total distance to 95.6 km. As at present determined, the new line would follow a route through two adjoining valleys, that of the Mogy river, at present used for the inclined planes, and the Quilombo river. The total expenditure, including electrification, is estimated at between £4,000,000 and £5,000,000.—*Reuter's Trade Service* (Sao Paulo).

Continental.—ITALY.—An underground railway estimated to cost approximately £8,000,000 is to be constructed in Rome. Three separate lines will connect the city with the principal residential districts, the total length of the railway according to the initial scheme amounting to about fifteen miles.

London.—TRAMWAY EXTENSIONS.—The London County Council Highways Committee recommends the construction of tramways in the section of the South Circular Road from Eltham Road to Well Hall Road, at an estimated cost of £18,000.

EXPERIMENTAL TRAMCAR.—The Highways Committee of the London County Council reports that, in view of the present-day trend towards improvement in design and appearance of public service vehicles, and in order that the tramcars of London shall not be lacking in this respect, it considers that steps should be taken to explore the possibility of improving upon the latest type of car approved for use on the Council's system. The Committee recommends, therefore, that a sum of £5,000 be expended on the construction of an experimental tramcar.

Swansea.—TRAMWAY RECONSTRUCTION.—The Corporation Tramways Committee has authorised the borough engineer to proceed with the reconstruction of the tramway track in Mansel Street and Cradock Street, and with the work in connection with the proposed scheme for the widening of St. Helen's Road for the doubling of the track.

The Southern Railway.—COLLISION.—A collision occurred in the fog on December 11th between two electric trains at Purley Station, shortly after 5 p.m. One coach was derailed but, although the line was not completely cleared till late in the evening, it was possible to maintain a 20-minute service throughout the evening. Two passengers were injured.

THE WIMBLEDON-SUTTON LINE.—January 5th is the date fixed for the opening of the Southern Railway Company's new line from Wimbledon to Sutton. An electric service of twenty minutes in rush hours, and 30 minutes at other times, will operate between Holborn Viaduct and West Croydon, connecting at Sutton with services to and from Victoria, and at Wimbledon with services to and from Waterloo.

Telegraph and Telephone Notes.

Radio Beacons.—PLYMOUTH.—The Great Western Railway Company is considering the construction of a beam radio beacon to assist the navigation of shipping in Plymouth Sound during fog. The only stations of the kind proposed in the west at present are at Start Point and The Lizard. The company contemplates erecting a new directional beacon at Penlee Point, at the western end of Plymouth Sound. The company, which owns the docks at Plymouth, is prepared to bear the cost of building and equipping the station and necessary apparatus, but *The Times* understands that it is not prepared to undertake an annual expenditure of £600 to £1,000 on maintenance.

Rumania.—TELEPHONE SERVICE.—It is reported from Berlin that a representative of the A.E.G. has made an offer to the Rumanian Ministry of Communications to modernise the country's telephone system. In particular, the proposal aims at the establishment of automatic exchanges in large cities, the laying of underground cables, and the supply of telephone apparatus and accessories. As the A.E.G. itself does not produce telephone apparatus, it is assumed that the negotiations are being made on behalf of some firm connected with the Berlin company.

Spain.—RADIO TELEPHONY.—A new radio-telephone service linking up Spain and Chile, South America, was inaugurated on December 20th.—*Reuter's* (Madrid).

The Telephone Service.—WESTERN SCOTLAND.—Telephone communication by submarine cable has been established between Oban and the island of Kerrara, in Oban Bay, the first of the Western Isles to have a direct telephone service to the mainland.

RURAL AUTOMATIC EXCHANGE.—A new exchange of the rural automatic type has been provided for the Great Alne district. Local subscribers will dial each other direct, but outside area calls will pass through the Alcester exchange operators.

Transatlantic Cables.—OCEAN BED CHANGES.—According to reports from the cable steamers now attempting to repair the submarine telegraph cable breaks caused by the earthquake off the North American East Atlantic coast, the ocean bed has been radically changed over the affected area and will need to be recharted. Soundings taken over an area of 200 miles' length when approaching Cape Race showed variations as great as 40 to 50 fathoms from the soundings recorded on existing charts; only a few of the chart soundings were found to be correct.

U.S.A.—CABLE AND WIRELESS UNIFICATION.—The regulation of the communication system, including radio, cables, and land wires, preferably by a special Minister of Communications who would be a member of the Cabinet, was recommended by General Harbord, president of the Radio Corporation of America, before the Senate Committee on Inter-State Commerce. He strongly urged legislative action to permit the creation of a unified communication service under the control of one authority.—*Reuter's* (Washington).

Radio Notes.

Australia.—POLICY CHANGE?—The recent Federal election having resulted in the formation of a Labour Government in succession to the Nationalist Ministry may mean another change in broadcasting policy. It is pointed out that the Prime Minister favours "Government ownership and control," but just what he meant by that statement is not clear.

Brookman's Park.—ALTERNATIVE TEST.—On Sunday, December 22nd, and on every Sunday until further notice, an alternative programme test transmission was radiated from 2 to 3 p.m. by the two transmitters at Brookman's Park and Daventry (5XX). This test was added to the existing series in order to assist those who cannot take advantage either of the morning or evening tests on week-days. One transmitter at Brookman's Park radiated on the regional programme wave-length of 356.3 metres, while the other radiated on the national programme wave-length of 261.3 metres. Daventry (5XX) radiated the same programme as the 261-metre Brookman's Park transmitter.

Licences.—EVASION.—At Bolton on December 12th a Post Office official said that considerable evasion was still going on in wireless licences. It was difficult to detect cases, however. An offender who was charged with installing a three-valve set and working the apparatus without a licence, and was fined £1 and £2 2s. costs, said he had an indoor aerial and was under the impression that it was not necessary to take out a licence until the set was working properly.

South Africa.—LICENCES.—There are approximately 16,500 licensed listeners in the Union, who, however, can obtain reliable reception from one of three stations only. Johannesburg claims 6,900, Cape Town 5,500, and Durban 4,100. The African Broadcasting Co. continues to loose considerable money annually, says *Wold-Radio*, and the Press is advocating State control of the service with the Canadian system as a possible example.

U.S.A.—STATION SITES.—The State of New Jersey has taken legal steps to defend its "right of denial or acceptance" concerning broadcasting concerns which wish to set up transmitters within the confines of the State. The specific question to be settled is whether the Columbia system shall be permitted to install, without New Jersey's sanction, its new 50,000-watt transmitter at Columbia Bridge, near Morristown, in accordance with a permit issued recently by the Federal Radio Commission, and the result will set a legal precedent for every State in the Union. It is contended by the New Jersey Radio Commission that the new WABC high-power transmitter, if placed near Morristown, will effectively "blanket that city, together with Montclair, The Oranges, and Newark," and New Jersey thinks it should have a say in the question whether any such broadcaster may set up a station on State soil without the people having a voice in the matter, as it is claimed that such transmitters ruin reception for listeners who reside nearby.

Contract Information.

When "Contracts Open" are advertised in our "Official Notice" pages, the date of the ELECTRICAL REVIEW containing the advertisement is given in parentheses below.

Contracts Open.

Australia.—MELBOURNE.—Posts and Telegraph Department. February 18th. Jacks and number plates. (B.X. 5940.)*

February 25th. Jumper rings and terminal strips. (B.X. 5941.)*

February 26th. Victorian Railways. Deaerators and accessories. (A.X. 8935.)*

Belgium.—January 8th. Belgian Posts and Telegraphs. Salle Madeleine, Brussels. 250 tons of bronze wire, in five lots, and five tons of annealed soft copper wire. Particulars (Cahier des Charges Special No. 3455) for 2½ francs.

Bradford.—December 31st. Corporation electric passenger- and goods lifts at block at shop and office premises, Leeds Road, Bradford Street, and Hall Buildings. Form of tender from city architect, Town Hall.

Dumbartonshire.—The Education Authority is inviting tenders for the installation of electric light in Cardross Public School.

Dundee.—January 15th. Electricity Department. Supply of two 300-kVA outdoor-type transformers and one 200-kVA outdoor-type transformer. (December 20th.)

Grimsby.—January 23rd. Electricity Department. One 10,000-kW, 3-phase turbo-alternator with condensing plant. (See this issue.)

India.—South Indian Railway Co., Ltd. January 24th. Madras improvements, electrification, cables, and accessories. (See this issue.)

London.—CENTRAL ELECTRICITY BOARD.—January 6th. Supply, delivery, and erection of 132-kV overhead transmission lines (special crossings and high spans), for the North-West England and North Wales Electricity Scheme, 1928. (November 29th.)

January 20th. Supply, delivery, and erection of 3,300-V, 6,600-V and 11,000-V switchgear for connecting the Board's supply to undertakers' busbars, North-West England and North Wales Scheme. (December 13th.)

ISLINGTON.—Borough Council. January 17th. Electrical and engineers' stores for one year commencing April 1st next. (December 13th.)

METROPOLITAN ASYLUMS BOARD.—January 2nd. Replating a 500-ampere-hour electrical storage battery at St. Luke's Hospital, Lowestoft. (December 13th.)

Lourenço Marques.—January 3rd. Tender Department of the Treasury. One oil-engine-driven d.c. generator and battery. (B.X. 5961.)*

Maidstone.—January 16th. Committee of Visitors. Electrical installation for lighting, heating, &c., at the Mental Hospital, Barming Heath. (December 20th.)

New Zealand.—WELLINGTON.—Post and Telegraph Department. January 21st. Spare parts for automatic telephones. (B.X. 5917.)* Reed-type tension gauges. (B.X. 5918.)*

January 27th. Breastplate transmitters. (B.X. 5956.)*

February 3rd. Protector blocks made of carbon and porcelain. (B.X. 5948.)*

February 13th. Opal lamp caps. (B.X. 5955.)*

Public Works Department. January 21st. Four electric motor-driven ventilating fans. (A.X. 8857.)*

South Africa.—PORT ELIZABETH.—January 9th. City Council. Electric cables, transformers, and sundry electrical materials. (B.X. 5960.)*

Stoke-on-Trent.—December 31st. North-West Midlands Joint Electricity Authority. Supply and erection of e.h.p. and l.p. overhead transmission lines. (December 13th.)

* Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Contracts Closed.

Bedford.—Education Committee. Recommended:—
Tubular electric heating at Ampthill Road schools (£762).—Young, Osmond & Young, Ltd.

Bexhill.—Health Committee. Recommended:—
Electric lighting and power installation at isolation hospital (£149).—H. W. Elsworth.

Dumfries.—Dumfries and Galloway Joint Sanatorium Board. Accepted:—
Accumulator for the sanatorium (£534).—Hart Accumulator Co., Ltd.

Town Council:—
Main switchgear, etc., for the new turbo-alternator plant (£534).—Metropolitan-Vickers Electrical Co., Ltd.

Government Contracts.—The following contracts were placed by Government Departments during November:—

ADMIRALTY (CONTRACT AND PURCHASE DEPARTMENT).
Motor alternators.—Haslam & Newton, Ltd.
Electric cables.—Anchor Cable Co., Ltd.; British Insulated Cables, Ltd.; Craigpark Electric Cable Co., Ltd.; Enfield Cable Works, Ltd.; Pirelli-General Cable Works, Ltd.; W. T. Glover & Co., Ltd.; Greengate and Irwell Rubber Co., Ltd.; Hackbridge Cable Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Hooper's Telegraph and India Rubber Co., Ltd.; India Rubber, Gutta Percha & Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Liverpool Electric Cable Co., Ltd.; Macintosh Cable Co., Ltd.; Mersey Cable Works, Ltd.; St. Helens Cable & Rubber Co., Ltd.; Siemens Bros. & Co., Ltd.

Petrol-electric mobile crane.—Ransomes & Rapier, Ltd.
Electric overhead cranes.—Vaughan Crane Co., Ltd.; Cowans, Sheldon & Co., Ltd.
Floodlights.—Engineering & Lighting Equipment Co., Ltd.
Generating sets.—Petters, Ltd.; Ferry Engine Co.; A. G. Mumford, Ltd.
Motor-generator set.—British Thomson-Houston Co., Ltd.
Electrical installation.—British Thomson-Houston Co., Ltd.
Control panel, switchboard, &c.—Whipp & Bourne, Ltd.
Electric overhead travellers.—Cowans, Sheldon & Co., Ltd.
Conduit tubing.—General Electric Co., Ltd.

WAR OFFICE.

Generators.—British Thomson-Houston Co., Ltd.
Electric lamps.—British Thomson-Houston Co., Ltd.
Electric cranes.—Herbert Morris, Ltd.
Battery for electric locomotive.—D.P. Battery Co., Ltd.

AIR MINISTRY.

Electrical controls.—Williamson Manufacturing Co., Ltd.
Fans.—General Electric Co., Ltd.; F. & C. Osler, Ltd.
Aircraft sparking plugs.—K.L.G. Sparking Plug Co., Ltd.
Dimmer switches.—Pyne Manufacturing Co., Ltd.
Sparking plug testers.—Adamant Engineering Co., Ltd.
W/t valves.—A. C. Cossor, Ltd.; Edison Swan Electric Co., Ltd.; General Electric Co., Ltd.
Wavemeter spares.—Marconi's Wireless Telegraph Co., Ltd.

POST OFFICE.

Telephonic apparatus.—Automatic Telephone Manufacturing Co., Ltd.; General Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.; Siemens, Bros. and Co., Ltd.; Standard Telephones & Cables, Ltd.; Sterling Telephone & Electric Co., Ltd
Testing and protective apparatus.—General Electric Co., Ltd.; Phœnix Telephone & Electric Works, Ltd.
Wireless apparatus.—David Brown & Sons (Huddersfield), Ltd.; General Electric Co., Ltd.
Cable.—British Insulated Cables, Ltd.; Connollys (Blackley), Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Johnson & Phillips, Ltd.; Pirelli-General Cable Works, Ltd.; Siemens Bros. and Co., Ltd.; Standard Telephones & Cables, Ltd.
Loading coils.—Standard Telephones & Cables, Ltd.
Telephone cords.—British Insulated Cables, Ltd.; Phœnix Telephone & Electric Works, Ltd.; Reliance Electrical Wire Co.; Standard Telephones & Cables, Ltd.
Manufacture, supply, drawing-in, and jointing of cable.—Salisbury-Basingstoke.—Pirelli-General Cable Works, Ltd.
Telephone exchange equipment.—Hop (London, S.E.), Smethwick (Birmingham), Basford (Nottingham), Sydenham and Woking.—Automatic Telephone Manufacturing Co., Ltd. Didsbury (Manchester).—General Electric Co., Ltd. Silverhorn (Chingford).—Standard Telephones & Cables, Ltd. Sub-contractors: Crompton Parkinson, Ltd., for ringing machines; Electric Construction Co., Ltd., for charging machines; Chloride Electrical Storage Co., Ltd., for batteries. Southend-on-Sea (Multi Area).—Standard Telephones and Cables, Ltd. Popesgrove (Twickenham), Rock Ferry.—Siemens Bros. & Co., Ltd.
Telephonic repeater equipment: Canterbury.—General Electric Co., Ltd. Dundee.—Standard Telephones and Cables, Ltd.
Power plant for repeater station.—Haslam & Newton, Ltd.

CROWN AGENTS FOR THE COLONIES.

Battery materials.—Chloride Electrical Storage, Ltd.
Cable.—Callender's Cable & Construction Co., Ltd.
Electric meters.—Ferranti, Ltd.
Insulators and ironwork.—Bullers, Ltd.
Ironwork.—Siemens Bros. & Co., Ltd.
Motor-alternator exciter sets.—Electric Construction Co., Ltd.
Static transformers.— Johnson & Phillips, Ltd.
Telephones.—Ericsson Telephones, Ltd.; General Electric Co., Ltd.
Wireless apparatus.—Marconi's Wireless Telegraph Co., Ltd.

Ilford.—Tramways Committee. Recommended:—
Three car bodies (£3,810).—Brush Electrical Engineering Co., Ltd.

London. — SHOREDITCH. — Lighting Committee. Recommended:—
Boiler (100,000 lb. per hour evaporative capacity) and auxiliaries (£21,174).—Stirling Boiler Co., Ltd.
HAMMERSMITH.—Electricity Committee. Recommended:—
Three 100-kVA 3-phase transformers (£1,177).—British Electric Transformer Co., Ltd.
HACKNEY.—Electricity Committee. Accepted:—
Boilers and coal handling plant for the Millfields Road generating station (approx. £250,000).—Simon-Carves, Ltd.
STOKE NEWINGTON.—Electricity Committee. Recommended:
Lamp columns.—Bromford Tube Co., Ltd.
Lanterns.—Holophane, Ltd.
Time switches.—Acme Lighting & Engineering Co.

Mersey Railway.—Accepted:—
3,800 Osram lamps for station lighting.—General Electric Co., Ltd.

Forthcoming Events.

Schoolboys' Exhibition.—Horticultural Hall, S.W., December 31st—January 8th.
Physical Society.—Thursday, January 2nd, Imperial College of Science, S. Kensington, S.W., 5 p.m. Ordinary meeting.
Institution of Electrical Engineers (Meter & Instrument Section).—Friday, January 3rd. Institution, Savoy Place, W.C., 7 p.m. "Instrument Transformers." Mr. J. G. Wellings and Mr. C. G. Mayo.
Institution of Mechanical Engineers.—Friday, January 3rd, Institution, Storey's Gate, S.W., 6 p.m. Thomas Lowe Gray Lecture. "Progress in Marine Engineering." Eng.-Vice-Admiral R. W. Skelton.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We shall be glad to learn the names and addresses of makers of the following:—

We are asked for the present address of the SANITAS ELECTRICAL Co., late of 61, New Cavendish Street, London.

Notes.

Snow Disturbances on H.V. Transmission Lines.

At the recent International Conference on High-voltage Transmission Distribution Systems in Paris, Mr. S. Fukunaka and Mr. T. Uyeno, two Japanese electrical engineers, presented a report on disturbances caused by snow on the 154-kV power transmission lines of the Nippon Electric Power Co. The authors explained that snow which weighed only about 1¼ lb. per cu. ft. rarely accumulated on the accumulators to an extent to affect the sag of lines, it being usually blown off by the wind before it could adhere to the conductors. On the other hand, dense snow weighing over 1¼ lb. per cu. ft. stuck to the periphery of the lines, this often being experienced to the extent of a diameter of 10 in. If the layer of snow formed uniformly along the whole length of the line span the normal sag, owing to the increased weight, was increased about five times. In practice, however, the snow did not accumulate evenly, but settled on the most inclined portions and slid down and fell off rapidly. On one line that was carefully inspected the sag was increased to twice the normal by snow. When snow collected evenly on the whole length of a line consisting of three conductors, the increase in the sag was the same for each conductor, so that no disturbance was caused, but when the temperature rose, the accumulated snow commenced to fall off, giving rise to both vertical and horizontal movements of the conductors. Although the horizontal movements were not so great as the vertical ones, the resulting motion of the conductors which underwent a rapid change in weight caused a wave of which a short-circuit between the different phases was the natural result.

The authors reported that they had found the best method of dealing with such conditions to be that of melting the snow by the passage of an intense current before the accumulation became such as to cause disturbances. Following a series of tests, it had been found that a 400-A loading for from 20 to 30 minutes was sufficient to bring about the melting of the inner lay of snow, which quickly caused the outer layers to fall away. The current was passed through the conductors circuit by circuit, men being employed to pass signals to the controlling station that the line had been cleared of snow, so that the current could be turned over to the next circuit. The work was usually carried out between 4 and 8 a.m., and since the plan was adopted there had been a marked decline in the number of line disturbances due to snow.

Open-door Losses of Electric Furnaces.

The open-door losses for a given furnace temperature will depend upon the area of door opening, time door remains open, the number of openings per hour and design of furnace front and door. There are so many variables that it is not possible to give an average figure for this loss. If a door is opened once or twice an hour for very short periods, this loss can be neglected, but in the case of a box type vitreous enamelling furnace, when the door is opened 30 to 40 times an hour, this loss may exceed the stand-by loss.

An actual test of a box type furnace operating at 1,600 deg. F., having a door 4 ft. wide, opened a distance of 18 in. high for a period of ten seconds plus an additional eight seconds for opening and closing, gave a loss of 1 kWh for each time door was opened.—*Electrical World.*

An American Diesel-Electric Tanker.

Construction is about to commence in the United States of a Diesel-electric tanker to operate between ports along the Atlantic coast. Her capacity will be approximately 20,000 barrels of petrol and approximately 55,000 gallons of lubricating oil, the latter to be carried in individual tanks in the forward hold space. The vessel will be very similar to one recently completed, and she will have a length of 255 ft., a beam of 44 ft., a draught of approximately 15 ft. 6 in., and a dead-weight of about 2,400 tons. The power plant will consist of two 6-cylinder, non-reversible, solid-injection oil engines, each rated at 625 shaft-horse-power at 225 r.p.m. They will be directly-connected to two direct-current generators, each rated at 410 kW at 225 r.p.m., 250 volts, shunt-wound. In addition, there will be three auxiliary generators, each rated at 45 kW at 240 volts, compound wound; two of them will be mounted on shaft extensions of the main generators, and the third will be directly-connected to a 3-cylinder solid-injection engine. These three generators will furnish power for excitation and also for lighting and the operation of auxiliaries. The propulsion motor will be a double-unit machine rated at 1,000 shaft-horse-power at 130 r.p.m., 500 volts. It will consist of two 500-horse-power, 130 r.p.m., 250-volt motors mounted on a common shaft with two bearings and base. Propulsion control will be on the variable voltage system, arranged for operation from both the engine-room and the pilot-house. The electrical auxiliaries will include two main cargo pumps, rated 75 horse-power each; two lubricating-oil cargo pumps, rated 15 horse-power each; a number of other pumps, and deck and other auxiliaries, the whole having an aggregate rating of 210 horse-power. Cooking and heating will be carried out electrically also.

A Large Combustion Control Installation.

It is a matter of interest to know that the Hull Corporation Electricity Department has decided to adopt a complete system of "Hagan" automatic boiler control for the five Clarke Chapman boilers in the new boiler house. Each boiler has a normal evaporation of 80,000 lb. of steam per hour at a working presesur of 400 lb. per sq. inch. The boilers are equipped with type "L" chain-grate stokers of the Underfeed Stoker Co., Ltd. The "Hagan" system will be designed to control both fuel and air supplies in accordance with steam demand. The air supply will be controlled from a master regulator sensitive to minute variations of steam pressure by means of suitable dampers at the forced and induced draught fans, and the fuel supply will be similarly controlled from the master regulator by regulating speed of the stoker motors. For this purpose d.c. variable-speed motors will be installed, one motor per stoker, and the automatic switchgear will be designed in such a way that small hand adjustments can at any time be made if desirable when variations in fuel quality take place. A separate regulator for each boiler will check automatically the draught variation in that particular boiler by operating a damper in the forced-air duct. This system will embody control panels by means of which the load on each particular boiler will be able to be increased or decreased at will or from which the boiler can be regulated by hand if at any time desired. These panels increase the flexibility of the system, and are supplied for practically all installations of "Hagan" automatic boiler control on large water tube boilers. The whole of this automatic system is being installed by James Gordon & Co., Ltd.

Reliability of Overhead Lines.

On a service basis good transmission practice is subject to 15 or 20 interruptions per year per one hundred miles of 100-kV line, according to a survey made by the Great Lakes Engineering Section of the N.E.L.A. From seven to ten of these interruptions were attributed to lightning, and for two successive years lines without ground wires suffered almost twice as many lightning interruptions as did those provided with ground wires. These data undoubtedly show the ability of ground wires to reduce lightning troubles. But lightning troubles are less than 50 per cent. of the service interruptions, and there is a big opportunity for improvement in performance, by eliminating chances for mechanical failures, improving relay operation, providing for better switching and insuring proper clearances to ground and between phases. These things can be done to the advantage of the service.

The superior efficacy of the double-circuit line, as compared with the single-circuit line, is shown by the data in that only 15 per cent. of the troubles caused a simultaneous trip-out of both circuits. It is also interesting to note that only about 6 per cent. of lightning flashovers resulted in burnt-down lines and that data on porcelain injured from arcs or punctures were very meagre.

There is no reason to doubt the economic feasibility of reducing interruptions to the order of ten, instead of twenty, per year per hundred miles of line.—*Electrical World.*

A New Sun-Lamp.

A new type of sun-lamp for use in the home to aid the maintenance of health has been brought out in the United States. The bulb is made of special glass that eliminates the shorter ultra-violet rays, which, it is said, should be used only under the supervision of a physician; it permits only the passage of beneficial rays, corresponding to direct sunlight through a clear atmosphere at midsummer, so that goggles and other protective devices are, therefore, no more necessary when the lamp is used than when a person exposes himself to the natural sun. Short exposures, graduated daily, reaching a maximum of approximately 30 minutes, are recommended, which amount of exposure is believed to be sufficient to produce a gradual tan, without burning the skin. Within an ornamental reflecting shade at the top of the standard is the special bulb, much like the usual incandescent lamp in appearance. The base of the standard is an ornamental housing enclosing a transformer for reducing the domestic voltage from 110 volts to the operating potential of the lamp, which has a conveniently located operating switch on the upright shaft, can be plugged into any convenient outlet, and can be rolled easily from room to room. The lamp reflector is adjustable, so that it can be inclined at an angle when desired. A tungsten filament and a pair of tungsten electrodes are contained within the bulb. When switched on the filament is lighted to bright incandescence, and the heat so liberated quickly vaporises a small quantity of mercury within the bulb, so that within a second or so a mercury arc is set up between the two tungsten terminals that are attached to the same supports as is the filament. When the arc has fully developed, the circuit is completed between the tungsten electrodes, the path of least resistance, which action automatically cuts the filament out of circuit.

Appointments Vacant.

Engineer for the development of the showroom and the use of electricity for Chester City Council. Junior assistant mains engineer for Salford Corporation. Mains assistant (£251) for the City of Norwich Electricity Department. Assistant mains engineer (£212) for the City of Salford Electricity Department. E.H.P. cable-jointer (545 Rs. monthly) for the Calcutta Electric Supply Corporation. Power stations engineer (£900) for the City of Manchester Electricity Department. Borough electrical engineer for West Hartlepool Corporation. (See our advertisement pages to-day.)

Electrical Development in Norway.

Although since the 1914-18 war progress has been achieved in the production and distribution of electrical energy in practically all countries, it is in Norway, according to *Le Génie Civil*, that such progress, per head of population, attains the greatest importance. The capacity of the hydro-electric stations belonging to the State, to the towns, to other local administrations, and to private enterprise, reaches 500,000 kW. The distributing systems directed by municipal authorities amount to 95 per cent. of the total; the demand by the towns amounts to 243,000 kW, and by the other municipal authorities to 141,500 kW. The towns and municipal authorities supply electricity to 70 per cent. of the population, and the consumption per head is 282 watts in the towns and 131 watts in the rural districts. Owing to the wide employment of heating and cooking apparatus the generating stations are able to work five to six thousand hours per year at maximum load, a figure which is not attained in any other country, notwithstanding the heavy distributing cost due to there being only eight inhabitants per square kilometre. On the other hand, artificial light is employed for 1,200 hours per year, and domestic heating during six months out of the twelve. In Norway electricity is distributed uniformly at 50 periods, but at various voltages. The latter are now being standardised at 5, 10, 20, and 45 thousand volts for transmission and at 220 for distribution.

Birmingham Electric Club.

The annual general meeting of the Birmingham Electric Club on December 20th. Thirty-nine new members were elected during the 1929 session, bringing the total membership up to 263. The statement of accounts for the session shows an income of £311, resulting in a balance of £200.

Elements for Electric Heating Appliances.

A number of problems encountered in the application of heat by electrical resistors working in restricted space have been met by the use of the metal-sheathed type of element. Sheath elements consist, in general, of five parts—the sheath, the coiled resistor, the "cold" terminals, the connection terminals, and the insulation. The elements are made by winding a helix of nickel-chromium wire and attaching "cold" terminals of heavy nickel wire. The resistor, with its terminals, is assembled in a straight tube (of copper, steel, nickel, or other suitable material) and the tube is filled with the insulating material, *e.g.*, magnesium oxide; the whole element is then swaged until the magnesium oxide is highly compressed. The unit can be formed into intricate shapes, can be varied in length and wattage, and is adaptable to a very wide range of applications. The sheathing must be selected with due consideration of the conditions in which the unit will be required to work, and may be composed of a variety of materials, *e.g.*, a nickel-plated copper sheath is in use for heating oils used in frying, sheaths of nickel-copper-zinc alloy are employed for units working, for various purposes, up to 1,000 deg. F. (540 deg. C.), while monel metal and other special materials are used for certain specialised applications of the sheath-metal resistor.—*The Nickel Bulletin.*

Transatlantic Cable-telephony.

There is shortly to be laid across the Atlantic Ocean a submarine telephone cable to supplement the present long-wave Europe-America radio-telephony system. A telephone cable operating over such a distance involves special technical problems centred around the fact that the attenuation of the telephone currents increases enormously with frequency, and requires special amplification apparatus for correction. In the transatlantic radio system the length of the land line between London and Cupar (radio receiving station) is almost 450 miles and the line contains seven repeaters. It is obviously impracticable to dispose repeaters at intervals along the length of an Atlantic cable, so that the problem resolves itself into placing super-amplifiers at the ends of the cable. Recent patent literature indicates that the problem has been under consideration for some time and information available on the transmitting and receiving apparatus is novel and interesting. The design of the receiving amplifier is totally different from that of a normal amplifier, where constancy of amplification with frequency is generally the desideratum. In submarine cable telephony the amplification at the highest frequency of the commercial telephony range must be several thousand-fold that at the lowest frequency in order to cope with the enormous differential frequency characteristic of the proposed cable. In the special receiver the "correction" is obtained by using a combination of a screened-grid valve and a specially designed transformer having a resonance generally below 7,000 cycles. Several units, *i.e.*, valve and transformer, are wired in cascade to obtain the required correction and the output to the land-line is taken from a power valve as in standard repeaters. An intensity control is included in the design of the amplifier although the cable output will not vary considerably. Data obtained from measurements on an existing amplifier show that a voltage amplification of about 5 million at 2,000 cycles is within the compass of the apparatus. An even more remarkable feature, however, is that this figure is 40,000 times as great as the amplification at the lower end of the telephone frequency range (250 cycles). Repeaters used hitherto on land lines in 2-wire and 4-wire systems have voltage amplifications of 30 and 900, respectively, at 2,000 cycles.

At the transmitting end of the cable the received currents from the land line pass into a special shaping amplifier where the amplification increases rapidly with frequency so as to give a "shaped" input to the cable, this again being effected by means of the electrical combination already mentioned. The overall voltage amplification (in terms of "power amplification" this figure is 10^{16}) of the terminal apparatus—transmitter and receiver—is of the order of 10^8, which figure is unique in connection with cable telephony.

The preceding data have been taken from the specification of a patent recently granted to Dr. N. W. McLachlan and Mr. W. S. Smith.

"Exporting" Power from Switzerland.

In the last issue of the *Schweizer Industrie und Handel*, Mr. H. Demierre gives some interesting details of the growing "exportation" of electric power from Switzerland, which increased from 377 million kWh in 1920 to 1,034 million kWh in 1928. The author states that the export consists really in renting to foreign buyers a certain share of the power obtained from Swiss generating plant. Up to the end of 1928 the share available, by legal authorisation, from Swiss electricity stations for foreign utilisation amounted to 312,988 kWh, and was divided among various European countries in the following proportions:—Germany, 18 per cent.; France, 39 per cent.; Italy, 30 per cent.; and territory as yet undetermined, 30 per cent. Public opinion in Switzerland was again aroused last year by the operations of several foreign electrical enterprises which, according to the report of the Swiss Federal Water-Power Department, were endeavouring to set up hydro-electric stations in Switzerland to be financed, constructed, and entirely run by themselves for purposes of power exportation. In order to anticipate any possible danger of the internationalisation of a national wealth, the Federal Authorities decided, with the consent of Swiss producers and distributors of electrical energy, to determine the conditions authorising the construction of plant intended chiefly for power exportation, *viz.*, that Switzerland, and more particularly its producers of electrical energy, shall occupy permanently a predominant position as regards the administration and financing of the plant in question; the export of electricity at the price of production is forbidden; in case of prolonged drought, Switzerland is to be granted the possibility of utilising a part of the energy intended for exportation to cover its own needs; after a period of 20 years foreign participation may be cancelled, and the enterprises may be run, if necessary, exclusively to supply the Swiss market. Generally speaking, the Federal Authorities consider it is preferable to leave the management of Swiss exports of electricity to plant which, first of all, regularly supplies the Swiss market, rather than to concerns built purposely for exportation, in which case foreign influence and policy would be extremely difficult to detect.

Further, if properly regulated, exports may lead to combinations resulting in the mutual advantage of both countries. In this connection Mr. Demierre cites the case of the international negotiations in connection with a projected power station at Dogern, on the Rhine. The total Swiss share (54 per cent.) of the energy produced by that plant having been the object of a request for exportation in favour of the Rheinisch-Westfalische Elektrizitatswerk at Essen, the cantons of Basle-Town and Basle-Country expressed the desire to control the German share of the energy produced by another future international plant on the Rhine at Birsfelden, in return for the corresponding cessation of a right of option on the Dogern, or any other international Rhine plants' Swiss production. This request closely coincided with a proposition made by the State of Baden with a view to exchanging its share at Birsfelden against a corresponding amount of Swiss energy derived from the Dogern plant. As the Swiss share of the annual production at Dogern should attain a yearly average of 238.4 million kWh, and that of Baden at Birsfelden 144.6 kWh, the exchange of equal quantities of electrical energy would leave to Switzerland a bonus of 93.8 million kWh, *i.e.*, 21 per cent. of the energy produced by the Dogern plant.

Finally, Mr. Demierre mentions that the Swiss Federal Department for the Development of Water Power has adopted such a comprehensive system of statistics with regard to the technical and economic conditions of the Swiss hydro-electric industry that it is not only possible to calculate the exact amount of power obtainable from any given volume of water, but to make also an accurate estimate of the power which can be derived from artificial or natural water-basins. Further, statistics indicate at the end of each month the exact amount of energy produced during the preceding month, and determine the proportion of its utilisation within, as well as beyond, Swiss boundaries.

Industrial Lighting and Power Relationship.

The *Electrical World* gives the following table of lighting and power factors as the result of a comprehensive survey of twenty large and small industrial plants of various kinds:—

	Per Cent
Ratio of power to connected load	68.5
Ratio of light to connected load	31.5
Ratio of power demand to total demand	61.0
Ratio of light demand to total demand	39
Ratio of power demand to power connected load ...	48.7
Ratio of light demand to light connected load ...	65.8
Ratio of power kilowatt-hours to total kilowatt-hours	64.3
Ratio of light kilowatt-hours to total kilowatt-hours	35.7
Ratio of power revenue to total revenue	63.0
Ratio of light revenue to total revenue	37.0

Brass Annealing Furnaces.

Assumed data: (1) weight of charge, 8,000 lb. of brass; (2) temperature, 1,100 deg. F.; (3) weight of pans, 850 lb.; (4) total time for anneal, 1½ hours; (5) size of furnace, 6 ft. 6 in. wide by 17 ft. long by 2 ft. 6 in. high door opening; (6) furnace operated 24 hours per day. Absorption of charge, $8{,}000\times0.105\times1{,}030/3{,}412=252$ kWh; absorption of pans, $850\times0.14\times1{,}030/3{,}412=36$ kWh; stand-by losses (inside area of furnace 375 sq. ft.) $375\times1{,}100/10{,}000=41$ kWh per hour.

Summary of heat requirements: absorption of charge, 252 kWh; absorption of pans, 36 kWh; losses for 1½ hour $1\frac{1}{2}\times41$, 62 kWh; total power consumption per charge, 350 kWh.

Performance: 8,000 lb./350=23 lb. net per kWh; rating of furnace: $252+36/1\frac{1}{2}+41=233$ kW.

Since most of the heat absorbed by the charge must be supplied during the first part of the cycle, the rating of the furnace must be somewhat higher than that determined above. The rating of this furnace should be about 300 kW.

In actual operation a 300-kW furnace operating on 67- and 68-minute anneals at temperatures of 1,000 to 1,100 deg. F. handled from 4,600 to 7,470 lb. of brass product on pans weighing from 540 to 850 lb. with total kilowatt-hour consumptions of from 230 to 294. The output in pounds of brass per kilowatt-hour ranged from 20 to 25.4.—*Electrical World*

State Line Power Station, Indiana.

Information concerning the State Line power station, U.S.A., given in *Power* for December 3rd, supplements the general description included in its issue of October 29th.

This station, which was started up on October 22nd, is chiefly remarkable as containing the largest generating unit anywhere in service, *viz.*, 208,000 kW. The station has been designed for an ultimate capacity of approximately one million kW.

The present set comprises three elements, made up of a 76,000-kW high-pressure turbo-alternator, centrally located, with a 62,000-kW low-pressure turbo-alternator on each side. The additional 8,000-kW is due to the two 4,000-kW, 2,300-volt house generators, one mounted on the shaft of each low-pressure machine. All three elements of the unit operate at 1,800 r.p.m. and generate 3-phase 60-cycle current at 22,000 volts. The high-pressure prime mover is a 17-stage single-flow impulse turbine. Each low-pressure turbine is of the double-flow type, with 11 stages on either side of a central admission. Steam enters the turbine at 600 lb. per sq. in. and 730 deg. F. The performance diagram, made up for a load of 150,000 kW on the triple unit, shows a heat consumption of 13,420 B.t.u. per kWh. For feed-water heating there are five points of extraction, and the feed-water enters the boiler-feed headers at 380 deg. F. Loss of vacuum closes valves between the high- and low-pressure turbines. The six boilers of the initial installation have a maximum capacity of 450,000 lb. per hour. They are fired by pulverised fuel, and have full water-cooled furnaces.

The Electrical Association for Women.

On December 11th a large party of members of the Electrical Association for Women visited the London showrooms of Messrs. Berry's Electric (1928), Ltd., where a short talk on electric cooking was given by Mrs. A. Mole, and a lecture on water heating by Mr. Painton. Members were keenly interested in both these very important subjects, and there was a good discussion.

Wayleaves in Ireland.

According to the *Irish Electrician* the Ministry of Commerce for Northern Ireland has prescribed the following annual rentals (under Section 22 of the Electricity Supply Act, 1919) in respect of each double pole :—

(1) the sum of eight shillings per pole which impedes ploughing operations;

(2) the sum of four shillings per pole which impedes the mowing of grass;

(3) the sum of two shillings per pole in other cases;

(4) the sum of sixpence per stay.

It is pointed out that these terms are much more favourable than those to which the Central Electricity Board has had to agree in England and Scotland.

It is thought that in the Free State the general position is much simpler and probably a great deal more satisfactory from every point of view in the long run. The State has taken the fullest powers to erect its lines and apparatus anywhere. It is expected that as a consequence of a combination of absolute power and personal tact, the cost of the Free State transmission and distribution lines will be a great deal less than the cost of equivalent lines in Great Britain and Northern Ireland.

It was stated in the Dáil last session that the original intention to pay an annual wayleave rental on transmission pole sites had been superseded by the outright purchase of the sites. Hence the Electricity Supply Board when it takes over the scheme will have to pay interest on the money now capitalised for the purchase of the pole sites, instead of paying a perpetual yearly rental to the individual owners of the land on which the poles are placed. The capitalised value of the proposed rentals would presumably have been larger than the total amount now to be paid for the sites. The method possesses another advantage in that the Supply Board in due course will amortise its debt to the State, and thenceforward will hold the sites free of all charge.

Savoy Hotel and Theatre Lighting.

A discussion on the above subject took place at a meeting of the Illuminating Engineering Society recently held in the lecture theatre of the Home Office Industrial Museum, London, the chair being occupied by the president (Dr. J. W. T. Walsh, of the National Physical Laboratory, Teddington).

Mr. HOWARD M. ROBERTSON, M.C., F.R.I.B.A., said that in England architects had not taken full advantage of the technical resources of the electrical trades, nor of the advice that was at their disposal. On the Continent he felt they were still much ahead of England in dealing with the problem of internal and external lighting. With regard to the lighting of the Savoy Theatre, London, which installation had been carried out by himself and his partner, their object had been to get an effect of sunlight without glare, so that the audience might have that feeling of comfort that the sun imparted. To do so the light had to come from above, but without casting shadows, and after various experiments had been carried out they had found that it could be done by reflecting light at various angles, so that it hit the gilded surfaces of the walls and shone off them on to the people. The lights above the upper balcony, however, were kept cool in tone, as that part of the theatre was apt to be hot in itself; there they had a blue ceiling, and had cast light directly upon it. The front part of the ceiling was coffered, open, below the lamps, which were concealed on the audience side of each square and cast their light on to reflectors above each square, which again reflected the light down and on to the side walls. The reflectors were originally white stove enamelled, but produced too great a glare, so they had covered them with gold paint, thus making the light colour effect perfect for their purpose. That light was aided in the forepart of the house by a string of lamps round the front of the balconies, that strip being concealed in a plaster trough; the balcony front above it being gold, the reflected light was sunny. All the walls being gold and shining, they picked up light from everywhere, and there were no dark corners. They had no electrical fittings as ornaments in the front of the house, but in the corridors and bars they had some quite simple ones made of glass.

Mr. BASIL IONIDES said that, with the exception of a few isolated signs and shelters, London offered very little æsthetic pleasure in the external lighting of its buildings, and enterprise seemed to have stopped short at flood-lighting and the use of neon tubing, which was, however, used for the most part without taking advantage of its charming possibilities. In the lighting of the new approaches to the Savoy Hotel and the Savoy Theatre fronts, the designers had attempted to employ lighting as a more definitely architectural and decorative element; but at the Savoy the problem was complicated by the proximity of hotel and theatre. Too many lighting schemes, both here and abroad, were unsightly in daylight, which remark was particularly true of designs in which the naked bulb was exposed, or in which neon-tube effects were coarsely contrived. The French had been very successful in the latter field, and had "spotted" the mechanism of the tubing in such a way as to contribute to the general design.

The Savoy scheme was based upon the covered approaches and the idea of leading people towards the hotel and theatre, achieving some sort of a climax in the courtyard; to this end the lighting effects were carefully considered, but suggestions for treating the actual hotel front were not yet realised, so that the ensemble was, therefore, incomplete. The lighting of the shelters was by a series of closely-spaced bulbs on the outer edge of the outfit, concealed in "V"-shaped troughs of flashed opal glass.

The courtyard had been fitted with new rectangular hanging light boxes, which would possibly require less current and upkeep than trays or fittings of a complex design. The theatre front's main feature was a sign, consisting of large projecting wood letters. The theatre signs, five in number, were an interesting feature of the scheme; two employed "Ascog" cubes, and one was a flash sign with changing colours.

Fatalities.

George Taylor (58), of Morley, Yorks., received a fatal electric shock on December 6th while working in the dye-house of Messrs. Charles Scarth Bros., Ltd. He went to turn off the switch of a hydro-extractor and received a shock at 400 V.

An inquest was held at Bradford on December 17th on Arthur Illingworth (38), who received a fatal electric shock whilst repairing a defect in the flex connected with an electric iron at his home. The widow stated that almost immediately after her husband had gone into the scullery she heard a noise, and found him apparently dead. The inquest was adjourned.

Feeder Protection.

The figures accompanying the comparison between the effectiveness of the Merz-Price and the Metroplitan-Vickers Co.'s "Translay" protective systems, which appeared in our issue of December 6th, under the title of "Feeder Protection," might appear to indicate that the currents circulate in the secondary windings. As stated in the text, however, such currents are in opposition.

Institution of Electrical Engineers.

MEMBERSHIP CHANGES.—The December issue (Vol. 68, No. 396) of the Institution *Journal* contains a list of the members who have been transferred from one class to another according to the provisions of new Bye-laws 15 to 18.

WESTERN CENTRE DINNER.—The annual dinner of the Western Centre of the Institution is to be held at the Royal Hotel, Cardiff, on January 13th. Tickets will cost 10s. 6d. each, exclusive of wines, and ladies are again specially invited.

Our Personal Column.

Electrical men are invited to enable us to keep readers of the "Electrical Review" posted concerning their movements.

At a recent meeting of the Stoke-on-Trent Electricity Committee it was agreed that the employés of the Department should be transferred to the North-West Midlands Joint Electricity Authority with effect from April 1st next. The Committee considered the duties and responsibilities of the city electrical engineer, and it was unanimously resolved that while Mr. C. H. YEAMAN remained in the service of the Corporation, no alteration should be made in his status and that his remuneration should remain as at present.

The Sunderland Town Council has appointed Mr. A. B. MACLEAN, Newcastle, as chief assistant in the electricity undertaking at a salary of £800 per annum. A motion to advertise the position was negatived. Mr. MacLean is a partner in the firm of Mountain, Wood & MacLean, consulting engineers. He was educated at Glasgow University, and after serving with the British Thomson-Houston Co., Ltd., was with the Newcastle-upon-Tyne Electric Supply Co., Ltd., for about nine years.

Mr. BERNARD C. HOLDING, editor of *The Electrician*, has resigned the editorship to take up an appointment with the International Standard Electric Corporation, London, on January 1st.

The Southend-on-Sea Town Council has appointed Mr. A. C. JOHNSON, as borough electrical engineer in succession to Mr. R. Birkett as from October 1st, at a salary of £1,000 per annum for the first two years, rising by two annual increments of £100 to a maximum of £1,200. Mr. Johnson has been acting borough electrical engineer since March 22nd last, when Mr. Birkett was first granted sick leave.

The Aylesbury Town Council has appointed Mr. F. BENT, Bolton, as works superintendent at the electricity works.

The Barnes Urban Council has appointed Mr. BULLPITT to succeed Mr. G. C. Law, who has been appointed deputy electrical engineer and manager at Hammersmith, as assistant electrical engineer and station superintendent.

Mr. WOOD DEANE SNAPE, who, as reported in our "Business Notes," has taken over the business of L. Andrew & Co., Manchester, started his career in 1890 with the Silvertown Co. When Mr. L. Andrew relinquished the position of Manchester branch manager of the company in 1898, to commence business on his own account, Mr. Snape joined him, and their association was maintained up to the time of Mr. Andrew's death in December last year, when Mr. Snape became joint administrator of his estate.

Mr. C. HIGHAM, of Blackburn, who recently resigned from the council of the Municipal Tramways and Transport Association, of which he is a past president, has been elected an honorary member in recognition of his services. He was formerly chairman of the Blackburn Tramways Committee.

The Islington Electricity Committee has appointed Mr. JOHN W. A. PHEASANT, of Grimsby, as assistant and relief charge engineer, at £297 per annum.

The Redcar Town Council has increased the salary of the borough electrical engineer to £350 a year.

The chief officials of Oldham Corporation and the Tramways Committee have presented a standard lamp and shade and a cut glass rose bowl to Mr. C. JACKSON, late general manager of the tramways, who has left for Plymouth. The members of the Tramways Committee also presented him with a case of fish servers and eaters.

Mr. CHARLES FURNESS, borough electrical engineer and tramway manager, Blackpool, returned to his duties on December 16th, after his honeymoon tour in Italy. He was heartily welcomed by members of the Transport Committee. On December 19th, the works and administrative staffs presented Mr. Furness with a silver cigarette box, Mr. W. W. Parkinson performing the ceremony.

Obituary.—Dr. W. ROLLINS.—We have received from Dr. Samuel W. Ellsworth of Boston, U.S.A., an appreciation of the late Dr. William Rollins, of Boston, who died on October 18th, at the age of 77 years. One of the pioneers in the study of Roentgenology, following Professor Roentgen's epoch-making discovery in December 1895, Mr. William Rollins became one of the foremost investigators of that period by his contributions to the literature on X-rays. He foresaw the far-reaching benefits which Roentgen's discovery was destined to give to medicine, and in the new field thus offered, he pursued his investigations. Numerous reports of his research and experiments appeared in various medical and scientific journals, and he published them in book form in 1904 under the title of "Notes on X-light." He visualised not only the future value of the X-rays in medicine and gave directions for their use, but also realised the danger attendant upon the misuse of this powerful agent and prescribed safety methods for the operator and patient. During the year 1900 he made experiments with radio-active substances, which led him to believe in the value of radium as a therapeutic agent. He established a generous research foundation at the Smithsonian Institution, Washington, B.C.

Dr. Rollins was a frequent contributor to the ELECTRICAL REVIEW during his investigations on X-rays and radium, between the years 1894 and 1899, and many of these investigations were subsequently incorporated in his book.

Mr. G. ARCHER.—The Dublin Press reports the death, on December 6th, of Mr. Gilbert Archer, M.I.E.E., deputy city electrical engineer of Dublin. Mr. Archer was born in London in 1866 and was educated at Finsbury Technical College. He entered the service of the Dublin Electricity Department upon its inception in 1892.

Wills.—Sir H. A. KIRK, late director-in-chief of the Indo-European Telegraphs, left £3,217 gross and £3,011 net personalty.

The late Mr. ALFRED BAKER, general manager of the Birmingham Corporation Tramways Department, left estate valued at £17,180 (£15,790 net personalty).

Financial Section.

New Companies, Returns of Share Capital, Debenture Charges, Reports of Electrical Companies, Dividend Results, Transactions in Stocks and Shares.

New Companies Registered.

J. M. Pirie & Co. (London), Ltd.—Private company. Registered December 14th. Capital, £6,000 in £1 shares (5,000 7 per cent. cumulative preference and 1,000 ordinary). Objects:—To acquire the business of architectural metal workers carried on by J. M. Pirie & Co., Ltd., and/or N. T. Helme, and to carry on this and the business of manufacturers and designers of electric lighting fittings, lock manufacturers, brass founders, &c. The directors are:—N. T. Helme, 107, Beaufort Street, Chelsea, S.W.3; I. B. M. Pirie, address not stated; E. D. N. Pentecost, 31, Laleham Road, Catford, S.E.6. Secretary: E. D. N. Pentecost. Solicitors: Stow, Preston & Lyttelton, 12, Lincoln's Inn Fields, W.C.2.

Mycalex (Parent) Co., Ltd.—Private company. Registered December 12th. Capital, £25,000 in 10s. shares. Objects:—To acquire certain patents and the trade mark "Mycalex" used in connection therewith; to adopt an agreement with Hoare, Miller & Co. (owners of the said trade mark), the Brindaban Industrial Syndicate, Ltd., and E. H. Kinnard, whereby it is agreed, *inter alia*, to transfer the trade mark and the benefit of certain agreements relating thereto, and to carry on the business of manufacturers of, and dealers in mica "Mycalex," and all kinds of insulating material, metal merchants and contractors, ironmongers, electrical engineers, &c. The subscribers (each with one ordinary share) are:—A. H. Freeman, secretary, and A. Parker, cashier, both of 5, Holborn, E.C.1. The first directors are:—E. H. Kinnard, Capt. E. R. D. Hoare, and Sir Herbert Ingram, Bt. (all permanent) Solicitor: F. P. Woodcock, 5, Holborn, E.C.1.

Pembrokeshire Electrical Power and Distribution Co., Ltd.—Private company. Registered December 14th. Capital, £100 in £1 shares. Objects:—To carry on the business of suppliers and distributors of electricity in all its branches. The provisional directors are:—A. L. Davis, 51, Mansel Terrace, Swansea, clerk; Violet Daniel, 10, Verig Street, Manselton, Swansea, clerk. A. Bremner signs documents as manager (*pro tem.*). Qualification (of subsequent directors), £10. Solicitor: J. E. M. Crowther, 15, Abingdon Street, S.W.

Battery Services, Ltd.—Private company. Registered December 16th. Capital, £1,000 in £1 shares. Objects:—To carry on the business of manufacturers and repairers of, and dealers in automobiles, motor cars, motors and cycles, magnetos, dynamos, and all electrical equipment, &c. The permanent directors are:—W. H. Oliver, "Fellsyde," Manor Grove, Benton Park Estate, Newcastle-on-Tyne; T. Armstrong, Dene House, Ellison Place, Newcastle-on-Tyne; G. H. Patterson, address not stated. Registered office: 98a, New Bridge Street, Newcastle-on-Tyne.

Electro-Gas Camshafts, Ltd.—Private company. Registered December 19th. Capital, £10,000 in 9,000 8 per cent. cumulative preferred ordinary and 1,000 ordinary shares of £1 each. Objects: To acquire inventions relating to camshafts of all kinds or the process of electro-gas welding, &c., and to adopt an agreement with Westminster Securities, Ltd. The provisional directors are: T. M. Wechsler, The Mount, Shortlands, Kent, solicitor; S. H. E. Bunley, 38, Kingswood Avenue, N.W.6, articled clerk. Qualification: £250 shares. Solicitors: Kenneth Brown, Baker, Baker, Essex House, Essex Street, W.C.2.

Magenerator, Ltd.—Private company. Registered December 18th. Capital, £525 in 500 8 per cent. cumulative preference shares of £1 each and 500 ordinary shares of 1s. each. Objects: To carry on the business of manufacturers, repairers, importers and exporters of and wholesale and retail dealers in

magnetos, dynamos, self-starters, and other electrical equipment for mechanically-propelled vehicles or other purposes, &c. The directors are: F. H. McCardie, The Bungalow, Much Hadham, Herts. (director New Nimrod (1927), Ltd., and other companies); F. R. Woods, 215, Balfour Road, Ilford; W. E. G. Woods, 89, Wellesley Road, Ilford. Qualification: £1. Secretary: W. E. G. Woods. Registered office: 24, White Lion Street, Bishopsgate, E.C.

Tree-Top Electrical Services & Supplies, Ltd.—Private company. Registered December 17th. Capital, £2,000 in £1 shares. Objects: To carry on the business of electrical engineers, contractors, mechanical and general engineers, &c. The subscribers (each with one share) are: A. Miller, 23, Kennedy Drive, Glasgow, clerk; F. V. Cheshire, 226, Woodlands Road, Glasgow, electrical engineer. The first directors are not named. Registered office: 46, Gordon Street, Glasgow, C.1.

Official Returns of Electrical Companies.

Western Counties Electrical and Engineering Co., Ltd.—Capital, £6,000 in 3,000 preference and 3,000 ordinary shares of £1 each. Return dated July 11th, 1929. 2,015 preference and 2,026 ordinary shares taken up. £1,211 paid on 611 preference and 600 ordinary shares. £2,830 considered as paid on the remainder. Mortages and charges at date of return, nil. Since registered: Mortgages dated September 21st and 23rd, 1929, to secure £3,000 and £350, respectively.

A. Cunningham & Co. (Manchester), Ltd.—Capital, £4,000 in £1 shares. Return dated July 25th, 1929. 1,057 shares taken up. £586 paid (being £1 per share on 537 shares and 4s. per share on 500 shares). £20 considered as paid on 20 shares. £51 calls unpaid. Mortgages and charges, nil.

E. H. Millington & Co., Ltd.—Capital, £2,000 in £1 shares. Return dated August 26th, 1929. 752 shares taken up. £752 paid. Mortgages and charges, nil.

Culm Valley Electric Supply Co., Ltd.—Capital, £50,000 in 20,000 preference and 30,000 ordinary shares of £1 each. Return dated August 23rd, 1929. 1,000 preference and 15,490 ordinary shares taken up. £10,900 paid. £5,590 considered as paid. Mortgages and charges, nil.

National Electric Construction Co., Ltd.—Capital, £125,000 in 10s. shares. Return dated June 6th, 1929. 170,000 shares taken up. £75,574 10s. paid on 151,149 shares. £9,425 10s. considered as paid on 18,851 shares. Mortgages and charges, £75,000.

Madras Electric Supply Corporation, Ltd.—Capital, £800,000 in 473,200 ordinary and 326,800 preference shares of £1 each. Return dated June 26th, 1929. All shares taken up. £694,000 paid on 420,400 ordinary and 273,600 preference shares. £106,000 considered as paid on 52,800 ordinary and 53,200 preference shares. Mortgages and charges, £182,100 7 per cent. second (registered) debentures.

British Arc Welding Co., Ltd.—Capital, £50,000 in £10 shares. Return dated August 14th, 1929. 1,474 shares taken up. £12,740 paid. £2,000 considered as paid. Mortgages and charges, nil.

Wantage Electric Supply Co., Ltd.—Capital, £6,000 in 600 cumulative preference shares of £5 each and 3,000 ordinary shares of £1 each. Return dated July 10th, 1929. 240 preference and 2,202 ordinary shares taken up. £3,402 paid. Mortgages and charges, nil.

Wholesale Electric Lamp Co., Ltd.—Capital, £1,500 in £1 shares. Return dated August 22nd, 1929. All shares taken up. £1,500 paid. Mortgages and charges, nil.

Pettigrew & Merriman (1925), Ltd.—Capital, £250,000 in 125,000 preference shares of £1 each and 500,000 ordinary shares of 5s. each. Return dated September 13th, 1929. 125,000 preference and 435,600 ordinary shares taken up. £202,650 paid (being 15s. per share on the preference and 5s. per share on the ordinary shares). Mortgages and charges, nil.

W. Sisson & Co., Ltd.—Capital, £50,000 in 5,000 preference, 38,000 ordinary, and 7,000 deferred shares of £1 each. Return dated July 30th, 1929. 4,375 preference, 31,711 ordinary, and 7,000 deferred shares taken up. £28,686 paid on 4,375 preference and 24,311 ordinary shares. £14,400 considered as paid on 7,400 ordinary and 7,000 deferred shares. Mortgages and charges: Overdraft limit with Lloyd's Bank, Ltd., £15,000, but account was in credit at July 30th, 1929.

Clark & Moir, Ltd.—Particulars filed of £5,000 debentures authorised October 23rd, 1929, charged on the company's property, present and future, including uncalled capital, the amount of the present issue being £500.

Cleethorpes Radio Supply, Ltd.—A. J. Weaver, 77, Victoria Street, Grimsby, was appointed receiver on November 22nd, 1929, under powers contained in mortgage debentures dated April 23rd, 1923, and May 1st, 1929.

West Cambrian Power Co., Ltd.—Debenture charged on the company's undertaking and property, present and future, including uncalled capital, dated December 3rd, 1929, to secure all moneys due or to become due from the company to Barclay's Bank, Ltd.

Electro Dynamic Construction Co., Ltd.—Satisfaction in full (1) on November 7th, 1929, of four debentures authorised October 22nd, and registered October 28th, 1924, securing £250 each, and (2) on November 14th, of deposit of deeds with Barclay's Bank, Ltd., dated June 10th and registered June 18th, 1929.

Oriental Telephone & Electric Co., Ltd.—Satisfaction to the extent of £3,595 on December 10th, 1929, of debenture stock covered by trust deed dated June 28th, 1905, and supplemental deed dated June 12th, 1927, and registered July 11th, 1905, and July 20th, 1907, respectively.

General Electric Co., Ltd.—Satisfaction to the further extent of £232,580 on or before November 4th, 1929, of trust deed dated July 22nd, and registered July 26th, 1921, securing £3,500,000 mortgage debenture stock.

British Horo-Electric, Ltd.—Agreement dated December 6th, 1929, to secure £1,600, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: A. Bingguely, 77, Rue du Nord, La Chaux de Fonds, Switzerland.

Wm. Feather & Sons, Ltd. (formerly Electric Transport (Nelson), Ltd.).—Mortgage for £1,219 16s. 1d., dated October 26th, 1922, charged on eight houses in Varley Street, Colne (being property acquired by the company on November 23rd, 1929). Registered pursuant to Section 81 of the Companies Act, 1929. Mortgagees: Bingley Building Society.

City Notes.

Allen West & Co., Ltd.

The annual meeting of this company was held on December 19th, Mr. A. E. C. Slazenger (chairman) presiding. In presenting the report and accounts the chairman said the net profits amounted to £29,291, as compared with £24,224 in the preceding year. The twelve months covered by the accounts had shown the largest increase in turnover yet experienced by the company, and the orders in hand were 2½ times as large as at the date of the last balance sheet, notwithstanding the largely increased output which had been obtained. This increase was mainly in export business, where, contrary to the experience of the large electrical companies, better prices had been obtainable than in the home market. During the year the whole output of the company's new products had been sold on the Continent, as, owing to the rapid increase of the Continental demand, it had been impossible to allot any output to the home market. In view of this the company had bought the Government factory at Woolston and 83 acres of freehold land on terms which involved considerably less capital expenditure than the erection of a new factory. These buildings were ideal for the production of the company's heavier products, the space for which was limited in the present factories. They looked forward with the greatest confidence in view of the increasing recognition of the quality of the company's products for important users both at home and overseas. Before terminating the proceedings, he had a resolution to propose which afforded him very great pleasure, and that was to ask the shareholders to give a special vote of thanks to Mrs. Allen West for the very valuable work which she had rendered, without any charge, on behalf of the staff, which he could assure the shareholders had been much appreciated, especially by the female staff. The resolution was seconded by Mr. O. F. Best, a director, and carried amidst applause. Mrs. Allen West, in reply, said she was greatly surprised at the extraordinary amount of gratitude which was displayed by the employés for the slightest amount of help and attention. She paid a high tribute to the work of the staff and the *esprit de corps* which existed. The report and accounts were adopted.

Venezuela Telephone and Electrical Appliances Co., Ltd.

The annual meeting of this company was held on December 17th. Mr. H. S. Bennett, who presided in the absence of the chairman (Sir Alexander Roger), said that the past year was a particularly strenuous one for all the staff in Venezuela, as, apart from the increased work on the maintenance, traffic, and commercial sides contingent upon the normal growth of the company's business, much had been accomplished on capital account. The capital expenditure during the year was approximately £85,000, the largest sum spent in any one year since the inception of the company. When the 2,000 automatic lines now being installed in Caracas were completed, 8,000 lines would be connected to the Caracas exchange. The introduction of the automatic system had been a pronounced success, and further development of the Caracas and other neighbouring areas was

anticipated and planned for. It was expected to extend the automatic facilities to the towns of Maracay, Valencia, La Geraira, and Puerto Cabello. The authorities had consented to an increased tariff. At June 30th last subscribers numbered 9,465, an increase of 750 during the year. With the provision of additional plant facilities and by means of propaganda, he believed that a much larger rate of growth would be possible in the future. Their relations with the Government authorities were most friendly, and their co-operation was warmly appreciated by the local management and the Board. Mr. Wallis was relinquishing his position as active manager of the company, but had agreed to act in an advisory capacity. His successor was Mr. Vegas, formerly second in command. The report and accounts were adopted.

Cape Electric Tramways, Ltd.

Presiding at the annual meeting on December 18th, Mr. L. Breitmeyer said that during the period under review no change for the better had taken place as regarded motor-'bus competition, which had considerably increased. The traffic returns showed that in Cape Town the tramways carried 1,377,967 passengers fewer than in the preceding year, with a decrease in receipts of £19,644. In Port Elizabeth, there was an increase of 741,421 passengers. In the aggregate, 42,251,336 were carried, as against 41,493,331 in the preceding year, and the receipts were £444,185, as compared with £438,071. At the moment no change as regarded the control of passenger transport by the authorities had taken place, and the company was therefore still subjected to unfair competition. The Provincial Council, had, however, recently passed legislation giving wider powers to municipalities for the control of transport, and a Commission appointed by the Government had now practically completed its investigation upon the best means of dealing with the present uncontrolled road competition. It was expected that it would place its report before the Government before the end of the current year. In view of the legislation that had been passed, the outlook of the company was more encouraging than it had been for some time past. The report and accounts were adopted, and a resolution altering the articles of association to enable the control, management, and direction of the company to be transferred to South Africa, was also approved.

Stock Exchange Notices.

Dealings in the following have been allowed by the Committee, under Rule 159 :—

Low Temperature Carbonisation, Ltd.—110,409 ordinary shares of 2s. each fully paid, Nos. 8,892,932 to 9,003,340.

Northampton Electric Light & Power Co., Ltd.—£114,000 new 5 per cent. debenture stock, issued at £93 per cent., fully paid.

County of London Electric Supply Co., Ltd., 1,106,795 new ordinary shares of £1 each issued at 36s. per share, partly paid and fully paid, Nos. 6,820,385 to 7,937,179.

The undermentioned have been ordered to be officially quoted.

Davis and Timmins, Ltd.—40,000 6½ per cent. cumulative preference shares of £1 each fully paid, Nos. 110,001 to 150,000.

Underground Electric Railways Co. of London, Ltd.—5,313 ordinary shares of £1 each fully paid, Nos. 7,278,273 to 7,283,586.

Ceara Tramway, Light, and Power Co., Ltd.

The net revenue for the year ended June 30th was £28,147 (against £27,572 in 1927-28). After meeting debenture interest and again transferring £12,500 to reserve, the dividend is maintained at 5 per cent. free of tax, and £8,832 is carried forward. The report mentions the adverse effect of motor 'bus competition upon the tramway undertaking, which, however, was offset by increased sales of electricity and greater receipts from the company's own omnibuses. The increased demand for power necessitates the extension of the plant, and a complete unit, doubling the present effective capacity, is to be ordered. It is hoped to finance this without an issue of new capital. The death of Mr. C. Hunt, a director, is recorded.

Yarrow & Co., Ltd.

Mr. H. E. Yarrow, C.B.E. (chairman), presiding at the annual meeting on December 18th, said that depression and severe competition still prevailed in the shipbuilding industry, and it was considered advisable to carry forward the small profit which had been earned. In addition to large orders from shipping companies, the Yarrow boiler was now being extensively used in land power stations. Pulverised fuel developments were being closely watched, and recently a high-pressure boiler fitted with the company's pulverised fuel system had been installed at the works, providing a practical demonstration of the system.

Southern Canada Power Co.

The report of the company for the fiscal year ended September 30th shows steady expansion. The gross earnings were $2,095,912, as compared with $1,809,566 for the previous year. The net earnings, after deductions for interest and depreciation, were $791,792, as against $674,074, and after payment of dividends the surplus for the year amounted to $104,469, as compared with $68,097; this is added to the surplus brought forward of $234,818, making a total of $339,281 to the credit of the profit and loss account.

Companies Struck Off the Register.

The names of the undermentioned companies have been struck off the Register, and they are thereby dissolved :—

"Daisy" Vacuum Cleaner Co., Ltd.
Electric Car and Accessories Co., Ltd.
Farad Electrical Co., Ltd.
Insulated Cap and Rivet Co., Ltd.

Official Notice *re* Companies.

The names of the undermentioned companies will be struck off the Register at the expiration of three months unless cause is shown to the contrary :—

Dartmoor Electric Supply Co., Ltd.
Magneto and Spare Part Co., Ltd.
Napier-Kimber, Ltd.
Scholey & Co., Ltd.

Associated Telephone and Telegraph Co., Ltd.

The following quarterly dividends have been declared, payable on January 1st :—

Seven per cent. first preferred stock, quarterly dividend of $1.75 per share; $6 first preferred stock, quarterly dividend of $1.50 per share; class "'D"' stock, quarterly dividend of £1.00 per share; class "A" stock, quarterly dividend of $1.00 per share, plus an additional and participating dividend of 25 cents on class "A" stock.

Agricultural and General Engineers, Ltd.

The receipts for the past year declined from £90,309 to £53,496, the receipts from subsidiary companies having fallen from £69,531 to £33,902. After meeting expenses there remains a balance of £1,038 (against £35,840) which is added to the balance of £56,445 brought in, and the total (£57,483) is carried forward.

Mann, Egerton & Co., Ltd.

The report for the year ended September 30th records a net profit of £24,335, as compared with £30,674 in 1927-28. After meeting the preference dividend, the directors propose to allocate £7,510 to the service of funding certificates and to carry forward £10,302. In view of the difficulties of the period the result is considered to be "not unsatisfactory."

Calcutta Electric Supply Corporation, Ltd.

A special meeting of shareholders has been called for January 10th for the purpose of considering alterations to the company's articles of association. Some of these alterations are necessitated by the new Companies Act, but the directors also propose to restrict the holdings of foreigners to 20 per cent. of the whole share capital.

British Vacuum Cleaner and Engineering Co., Ltd.

The accounts for the year ended September 30th show a net profit of £6.638. From this a debit balance of £5,099 brought forward is deducted, leaving £1,539 to be carried to the next account.

Victoria Falls and Transvaal Power Co., Ltd.

The directors have declared an interim dividend of 3 per cent. on the preference shares, together with a further 3 per cent. in respect of participating rights. The ordinary shares are to receive 3 per cent.

Eastern Telegraph Co., Ltd.

The dividend on the preference stock for the quarter ending December 31st (at the rate of 3½ per cent. per annum), is to be paid on January 18th.

Northern Mexico Power and Development Co.

A dividend of 1¾ per cent. has been declared on the preference stock and 1 per cent. on the common stock, payable on January 2nd.

Brazilian Traction, Light and Power Co.

The regularly quarterly dividend of 50 cents per share has been declared on the ordinary shares. It is also proposed to pay a stock dividend of 1 per cent. on the ordinary shares.

Electric and General Investment Co., Ltd.

An interim dividend of 5 per cent. has been declared on the ordinary shares.

Montreal Light, Heat and Power Co.

A quarterly dividend of 60 cents per share has been declared.

Greenwood & Batley, Ltd.

The interim dividend is again 2½ per cent.

Stocks and Shares.

In consequence of the slackening of business on the Stock Exchange as the Christmas Holidays approached, and to the vacation period clashing this year with our usual printing time, our "Stocks and Shares" feature is withheld this week. At the time of going to press, depression in industrial securities continues owing to the effect of recent developments in both London and New York. The Exchange closed on Tuesday afternoon, and remains so on the day of issue of this number of the REVIEW.

Our Foreign Electrical Trade.

Electrical Exports and Imports during November.

IT was to be expected that there would be a reaction in November following the high levels reached by both imports and exports in the preceding month. The Board of Trade returns show, however, that this reaction was not great enough to bring either total below the figures for the corresponding month of last year.

The fall of £98,532 in the export total as compared with October was due to very large declines in telegraph and telephone wires and cables, both submarine and non-submarine. Apart from these, there were only three small decreases, all the other items being of larger dimensions. In the machinery section there was actually a net rise of £23,078 and insulated wires and cables showed the fairly substantial gain of £29,613. In comparison with November, 1928, the total showed a rise of £177,451, due mainly to advances in unenumerated goods (£88,505), insulated wires and cables (£81,857), and telegraph and telephone apparatus (£55,443). Opposed to these increases there was a decline of £78,125 in the machinery section, due, as we show below, to smaller shipments to Empire markets. Although the figure for the completed portion of the year shows a net rise of £924,641 as compared with the first eleven months of 1928, this has been entirely due to an advance in exports of electrical goods and apparatus; electrical machinery has registered a decrease of £372,211.

The imports remained at a very high level, exceeded only by the figure reached in the preceding month. The principal features as compared with that month were declines in imports of electrical machinery (£32,264), and of telegraph and telephone instruments and apparatus (£55,443). The increases were not of large dimensions. The total was well above that for the corresponding month of 1928 (£237,889) and the increase was general. Telegraph and telephone apparatus showed the greatest advance (£72,476), but there were also substantial rises in unenumerated goods, glow lamps, meters and instruments, machinery, and batteries and accumulators. There were three decreases but none was of great size. The increase in imports from January to November, as compared with the preceding year, represents about two months' supply.

The re-exports section shows an increase in both comparisons, the principal item being telegraph and telephone apparatus.

The following table shows the distribution of our November exports of electrical machinery, the figures being compared with those for November, 1928 :—

Destination.	Nov., 1928. £	Nov., 1929. £	Inc. or dec. £
Europe	87,962	95,962	+ 8,000
Japan	6,040	15,344	+ 9,304
South America ...	46,497	48,936	+ 2,439
South Africa ...	42,058	38,459	− 3,599
British India ...	186,255	92,370	−93,885
Australia	92,731	89,012	− 3,719
New Zealand ...	41,087	30,809	−10,278
Canada	49,569	48,160	− 1,409
Other Countries	100,071	115,063	+14,992
Totals ...	£652,240	£574,115	−£78,125

It is noteworthy that the Empire markets all registered declines while foreign countries increased their share. The continued rise of exports of electrical machinery to European markets is of considerable interest as indicating competitive efficiency in difficult circumstances.

	Exports.			Imports.			Re-Exports.		
	Electrical exports for Nov., 1929.	Inc. or dec. as compared with Oct., 1929.	Inc. or dec. as compared with Nov., 1928.	Electrical imports for Nov. 1929.	Inc. or dec. as compared with Oct., 1929.	Inc. or dec. as compared with Nov., 1928.	Electrical re-exports for Nov., 1929.	Inc. or dec. as compared with Oct., 1929.	Inc. or dec. as compared with Nov., 1928.
Electrical goods and apparatus (unenumerated)	£335,721 −	£7,610 +	£88,505	£213,077 +	£754 +	£45,429	£9,959 −	£1,887 +	£1,300
Insulated wires and cables ...	374,602 +	29,613 +	81,851	90,662 +	2,004 +	11,373	1,279 +	47 +	441
Glow lamps	66,697 −	8,135 +	16,305	60,750 −	12,375 +	37,290	1,301 +	459 +	516
Arc lamps and parts ...	4 213 +	672 +	1,606	2,325 −	5,071 −	509	14 −	10 −	45
Batteries and accumulators ...	96,132 +	8,400 +	12,965	132,060 +	34 +	20,702	653 −	433 −	603
Meters and instruments ...	33,456 +	329 −	3,882	53,299 +	3,398 +	31,155	697 +	237 +	359
Carbons	2,279 +	1,793 +	1,734	10,534 −	2,419 −	5,107	77 −	24 +	8
Switchboards (not telegraph or telephone)	7,395 +	1,417 +	2,459	12 −	231 −	639	8 −	4 −	203
Electrical Machinery—									
Electrical machinery (unenumerated)	335,220 +	5,023 −	28,204	161,190 −	32,264 +	26,202	13,390 +	2,119 −	4,928
Railway and tramway motors	19,162 −	3,098 −	17,090	—	—	—	—	—	—
Other motors and generators...	219,733 +	21,153 −	32,831	—	—	—	—	—	—
Telegraph and Telephone Cable and Material—									
Telegraph and telephone wires and cable (not submarine)	59,295 −	83,777 −	18,313	2,299 +	1,851 +	517	—	— −	10
Submarine telegraph and telephone cable	30,037 −	68,786 +	16,903	—	—	—	—	—	—
Telegraph and telephone instruments and apparatus ...	243,106 +	4,456 +	55,443	171,524 −	65,432 +	72,476	11,153 +	5,806 +	4,270
Totals	£1,827,048 −	£98,532 +	£177,451	£897,672 −	£109,751 +	£237,889	£38,531 +	£6,310 +	£1,105
	Exports			Imports			Re-Exports		
Inc. for eleven months of 1929	£924,641			£1,671,494			£24,781		

Minor African Markets.

The Electrical Import Trade of Nigeria, the Gold Coast, Tanganyika, Sierra Leone, Kenya and Uganda.

THE market for electrical goods in West and East Africa is steadily expanding, as will be seen from the following statistics relating to the Gold Coast, Nigeria, Sierra Leone, Kenya and Tanganyika, which have been compiled from official sources. The values for 1928 for all such goods are given below, with comparative figures for 1927 and notes of increases or decreases are added. Some remarkable increases are shown, the purchases of electrical and industrial machinery by the Gold Coast being particularly noteworthy. As to the prospects of future trade generally the official report on Nigeria for 1928 says that the desire for things modern and the money with which to purchase them is spreading quickly throughout the country, while the report on the Gold Coast, although recording a decrease in imports as well as exports, makes the comment that the Gold Coast native has not deprived himself of luxuries. With regard to the scheme for utilising the Pangani River Falls for supplying power to Dar-es-Salaam, Tanga, &c., it was recently stated that the Government of Tanganyika had decided to negotiate with the African General Development Company on the lines of a tender submitted. The sisal-producing companies are expected to be large users of power. General trade in recent months has been rather quiet in both Nigeria and the Gold Coast, largely owing to the weakness in the prices of the principal articles of export, *viz.*, tin, palm products and cocoa. The demand for imported merchandise has consequently slackened. Conditions as a whole in East Africa do not compare favourably with those ruling twelve months ago, except in the building trade.

Imports into Nigeria.

	1927. £	1928. £	Inc. or dec. £
Electrical machinery—			
Total	16,700	14,000	− 2,700
From United Kingdom ...	6,800	7,000	+ 200
,, U.K. Government...	8,600	4,500	− 4,100
,, United States ...	600	500	− 100
,, Germany	600	2,000	+ 1,400
Electrical and telegraphic apparatus—			
Total	36,500	79,000	+42,500
From United Kingdom ...	4,700	11,800	+ 7,100
,, U.K. Government...	27,800	63,000	+35,200
,, Germany	3,300	4,000	+ 700

Imports into the Gold Coast.

Electrical and telegraphic apparatus—			
Total	53,700	73,000	+19,300
From United Kingdom ...	6,400	25,000	+18,600
,, U.K. Government	42,000	43,000	+ 1,000
,, Germany	1,760	1,600	− 160
,, United States ...	2,600	3,000	+ 400
Electrical machinery—			
Total	37,000	58,000	+21,000
From United Kingdom ...	14,000	23,000	+ 9,000
,, U.K. Government	22,000	34,000	+12,000
,, Germany	500	—	− 500
,, United States ...	150	100	− 50
Telegraph and telephone instruments and apparatus —			
Total	3,400	29,500	+17,100
Ditto on Govt. account ...	3,800	10,200	+ 6,400
Engines, steam—			
Total	12,600	17,500	+ 4,900
From Great Britain ...	8,000	14,600	+ 6,600
,, United States ...	2,600	600	− 2,000
,, Germany	1,600	2,200	+ 600
Electric lamps—			
Total	2,100	3,200	+ 1,100
Ditto on Govt. account* ...	60	700	+ 640
Industrial machinery and parts—			
Total	130,000	204,000	+74,000
From United Kingdom ...	104,000	163,000	+59,000
,, India	4,000	2,300	− 1,700
,, Germany	8,000	13,000	+ 5,000
,, United States ...	5,000	22,000	+17,000
Ditto on Govt. account ...	17,000	12,000*	− 5,000
Pumps and pumping machinery—			
Total	12,000	26,000	+14,000
From United Kingdom ...	7,000	9,800	+ 2,800
,, United States ...	2,000	4,800	+ 2,800
,, France	—	11,000	+11,000
Machinery, not specified, other than agricultural—			
Total	33,000	48,000	+15,000
From United Kingdom ...	26,000	45,000	+19,000
,, Germany	4,000	1,000	− 3,000
,, United States ...	2,000	1,700	− 300
Ditto on Govt. account ...	33,000	31,500	− 1,500

Imports into Tanganyika.

Wires and cables, insulated—			
Total	1,700	2,600	+ 900
From United Kingdom ...	1,500	2,200	+ 700
,, Germany	150	350	+ 200
Electrical goods and apparatus, n.e.s.—			
Total	17,800	12,500	− 5,300
From United Kingdom ...	15,000	9,900	− 5,100
,, Germany	2,000	2,200	+ 200
Telegraph and telephone instruments and apparatus—			
Total	3,900	8,200	+ 4,300
From United Kingdom ...	3,800	8,200	+ 4,400
,, Germany	50	—	− 50
Electrical machinery—			
Total	3,900	11,000	+ 7,100
From United Kingdom ...	500	9,000	+ 8,500
,, Germany	3,300	1,200	− 2,100
Steam engines—			
Total	2,600	6,400	+ 3,800
From United Kingdom ...	1,700	3,400	+ 1,700
,, Germany	900	3,000	+ 2,100
Lamps and lanterns—			
Total	14,000	10,000	− 4,000
From United Kingdom ...	1,500	1,600	+ 100
,, United States ...	3,200	1,300	− 1,900
,, Germany	8,700	6,000	− 2,700

Imports into Sierra Leone.

Electrical and telegraphic apparatus—			
Total	21,000	35,000	+14,000
From United Kingdom ...	11,000	28,000	+17,000
,, U.K. Government...	9,000	6,000	− 3,000
Industrial machinery—			
Total	1,400	190	− 1,210
From United Kingdom ...	900	—	− 900
,, U.K. Government...	—	180	+ 180
,, Germany	400	—	− 400
Electrical machinery—			
Total	1,700	1,600	− 100
From United Kingdom ...	—	400	+ 400
,, U.K. Government...	1,700	780	− 920
,, Germany	—	300	+ 300

Imports into Kenya and Uganda.

Electric wires and cables, insulated—			
Total	3,700	13,000	+ 9,300
From Great Britain ...	3,100	12,800	+ 9,700
,, Germany	300	300	—
,, Belgium	275	—	− 275
Ditto on Govt. account* ...	150	3,200	+ 3,050
Electric wires and cables, uninsulated—			
Total	3,400	1,500	− 1,900
From Great Britain ...	2,400	1,300	− 1,100
,, Belgium	800	30	− 770
,, Germany	100	100	—
Electrical goods and apparatus, n.e.s.—			
Total	19,000	25,000	+ 6,000
From Great Britain ...	12,000	21,000	+ 9,000
,, Germany	1,600	1,500	− 100
,, United States ...	1,800	2,000	+ 200
,, Belgium	3,600	300	− 3,300
Ditto on Govt. account* ...	9,700*	3,900	− 5,800
Electrical machinery and parts—			
Total	22,000	36,000	+14,000
From Great Britain ...	13,000	25,600	+12,600
,, Belgium	800	—	− 800
,, Sweden	3,000	900	− 2,100
,, United States ...	5,000	7,800	+ 2,800
Ditto on Govt. account ...	2,000	2,100	+ 100

* Mainly from Great Britain.

Lead Mining under Helvellyn.

The reconstruction and extension of the equipment of one of the first metalliferous mines to use electricity underground.

ONE of the few remaining lead mines which are still worked in this country is that of the Greenside Mining Company, near the village of Glenridding, in Westmorland. This mine has been worked continuously for over a hundred years, and is believed to have been the first metalliferous mine to adopt the use of electricity underground. In the opinion of the owners the use of electricity has been an important contributory cause of the mine's success throughout the many vicissitudes which the industry has suffered and which have caused many mines to close down. The electrical equipment of the Greenside mine has recently been re-organised and extended, and it now constitutes an excellent example of up-to-date methods applied to very old workings.

As early as 1891 a complete system of electrical operation was adopted, with a hydro-electric power plant consisting of a 100-h.p. vortex turbine and a belt-driven 100-kW, 500-volt, d.c. generator. The energy was transmitted to the underground workings and used for hoisting, haulage, and for driving air compressors and for pumping. Reliability of the pumping equipment has always been of the utmost importance, as the lower levels of the mine are 2,160 ft. from the outcrop, and 180 ft. below the surface of Ullswater, near the south-west end of which the mine is situated.

Fig. 1.—The Greenside Lead Mine under a Spur of Helvellyn.

Fig. 1 is a general view of the mine. The ridge behind it is a northern spur of Helvellyn. To the right of the mine head is seen the stream which is used for power generation. In 1898 the d.c. generating plant was increased by the addition of a single-jet Gilkes Pelton wheel of 100 h.p., directly coupled to a 100-kW generator, but in 1911 the system was changed to a.c. operation, the two d.c. generating sets being replaced by a 250-h.p. double-runner twin-jet Gilkes Pelton wheel directly coupled to a 200-kW, 2,200-volt, 3-phase, 50-cycle "Metro-Vick" alternator. Fig. 3 shows this plant, which is still at work in the old No. 1 power station. It was supplemented in 1924 by a shaft governor-controlled "Turgo" impulse wheel, directly connected to a 110-kW alternator. The satisfactory performance of this unit led the management to adopt the same type of wheel and governor for its latest power station, which has been completed in the last few months. The new hydraulic plant has therefore been supplied by Messrs. Gilbert Gilkes and Gordon, Ltd. At the same time the electric plant has been completely re-organised and considerably extended, the work being carried out by the Metropolitan-Vickers Electrical Company, Ltd.

Fig. 2.—New Power House, showing Pipe Line.

The tail water of the old Pelton plant, and the water used for ore dressing and other purposes, is now collected by a small dam and diverted into a headrace canal, 4,500 ft. long, to the forebay of the new station. A pipeline of 21-in. bore, 1,530 ft. long, conducts the water to the power house, fig. 2, where it supplies two "Turgo" impulse wheels, directly connected to alternators of 110 kW and 250 kW capacity, respectively. The smaller of these machines is the "Turgo" wheel referred to above, moved from its old site to the present station. The larger was ordered last year, and erected some months ago. Fig. 4 shows the interior of the new power house with the two sets in service.

The technical data of the two units are of considerable interest to hydro-electric engineers, and are given in the table on p. 1159.

The most striking point is the high specific speed of the later set, resulting in marked economies, both on the hydraulic and electrical sides.

The speed control of the "Turgo" units presents another interesting feature of this installation. A powerful centrifugal pendulum is mounted on the water-wheel shaft, and its sleeve is directly connected to a deflector by links and levers without any servo-meter or relay. The deflector is interposed between the jet and the runner at reduced loads, and there is only allowed to act on the runner that portion of the jet which is necessary to carry the load. Thus if the load on the generator is light, practically all the jet is deflected; whereas if full load is

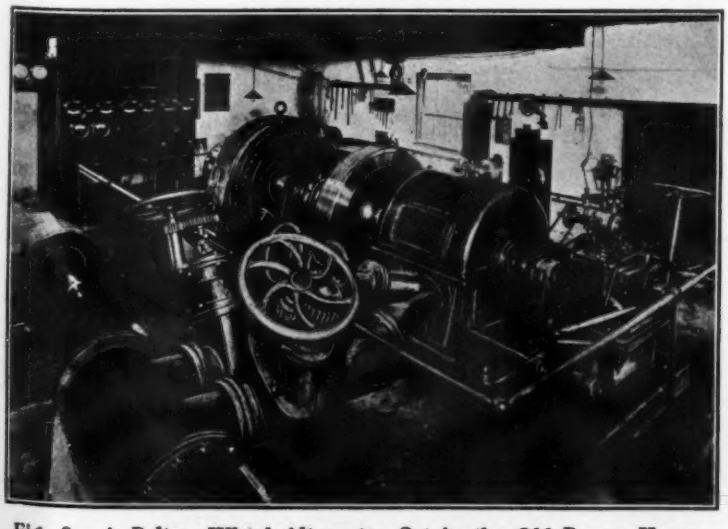


Fig. 3.—A Pelton Wheel Alternator Set in the Old Power House.

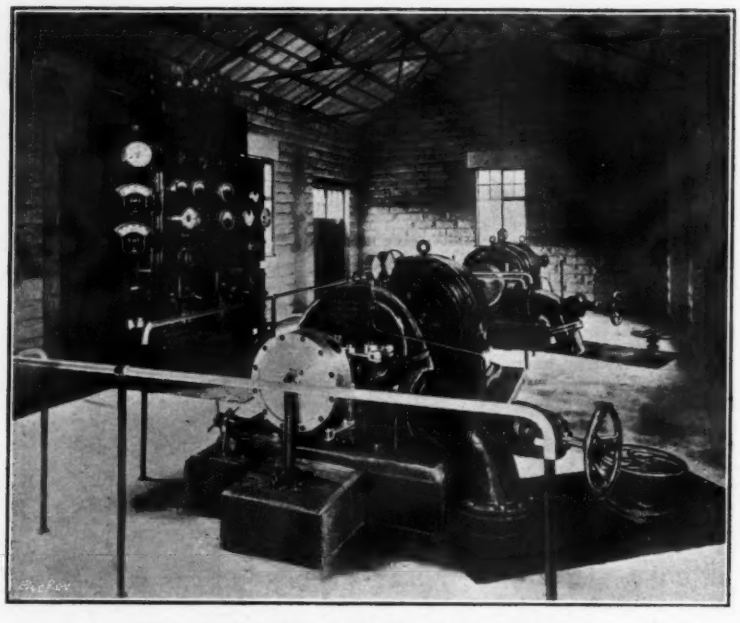


Fig. 4.—Interior of the New Power House.

required, the deflector is moved clear of the jet, which then impinges directly on the runner. The absence of relays enables a far quicker governing action to be obtained than is possible with a servometer-type of oil-pressure governor. With the whole load suddenly thrown off the momentary rise of speed is less than per cent.

The new and old power stations are arranged so that they may be operated in parallel, the synchronising equipment previously used for the two sets in No. 1 power station being now installed in the new power station for that purpose. Alternatively, either station may feed the system at times of light load. The supply from the new station to the point of junction with the No. 1 station supply line at the drift mouth of the Lucy Level, a distance of about 2,000 yards, is by means of a new overhead line mounted on wood poles. The supply to the underground workings is thence taken along the drift to a high-pressure distribution board 1,560 yards in-bye, fig. 7, consisting of three Metro-Vick draw-out type pillars, two pillars controlling lines to motors driving compressors, and one pillar controlling a line to the electric winders and the pumps.

The ore is brought up from the workings by two electric winders as shown in fig. 8. "Murray's winder" lifts the ore from the lowest workings, 360 ft. above sea-level, to a point 720 ft. above sea level. "Smith's winder" then lifts it from this level a further 540 ft. to the Lucy Level, where it is taken up the drift by an electric locomotive. Fig. 5 shows the lower winder, which has a 65-h.p. Metro-Vick induction motor driving the drum through double-reduction gearing with a shock-absorbing coupling. The upper winder is similar in arrangement, but has a 50-h.p. motor. The mechanical equipment of both winders is the original equipment used with the d.c. motor drives, which have now been superseded. Each induction motor is operated on a 650-volt supply provided by a transformer installed beside it, and is controlled by means of a switch pillar of the same type as those shown in fig. 7, together with a Metro-Vick cam-operated contactor-type controller, with resistances, connected in the rotor circuit. The equipment includes protective gear giving complete safeguard against such contingencies as overspeed, overwind, over-acceleration, or delayed retardation.

The pumps are driven by squirrel-cage motors operated with auto-transformer starters on a 650-volt supply from transformers beside them. At the 90-fathom level a new installation has been made consisting of a Mackley turbine pump driven at 1,450 r.p.m. by a directly-coupled 55-h.p. motor. At the 150-fathom level a new 20-h.p., 720-r.p.m. motor has been installed for an existing reciprocating pump, with belt driving to give the required speed of 225 r.p.m. on the pump pinion shaft. Two electrically driven air-compressors operate at the in-bye end of the Lucy Level drift. One of these is a "Sentinel" compressor driven by an existing 110-h.p., 440-volt motor. The other, a Walker compressor, has been equipped with a new 120-h.p., 2,000-volt motor with a liquid-type starter, fig. 6.

Advantage has been taken of the reorganisation of the equipment to provide electric driving in the workshops, which are about 100 yards from the drift mouth. For the blacksmith's shop a 35-h.p., 720-r.p.m., squirrel-cage motor has been installed, with an auto-transformer starter, belt driving on to shafting, and for the joiner's shop a 20-h.p., 720-r.p.m. motor of the same type is similarly arranged. The supply for these machines is tapped off the 2,200-volt overhead line and transformed down to 440 volts. Provision has also been made for electric lighting, both at the mine head and in the mine, the supply for this purpose being given at 110 volts by a number of small transformers installed at convenient places on the system.

The momentary rise in speed of less than two per cent. by the "Turgo" units represents a creditable achievement, considering that no flywheel is used on either set, and that no flywheel effect is

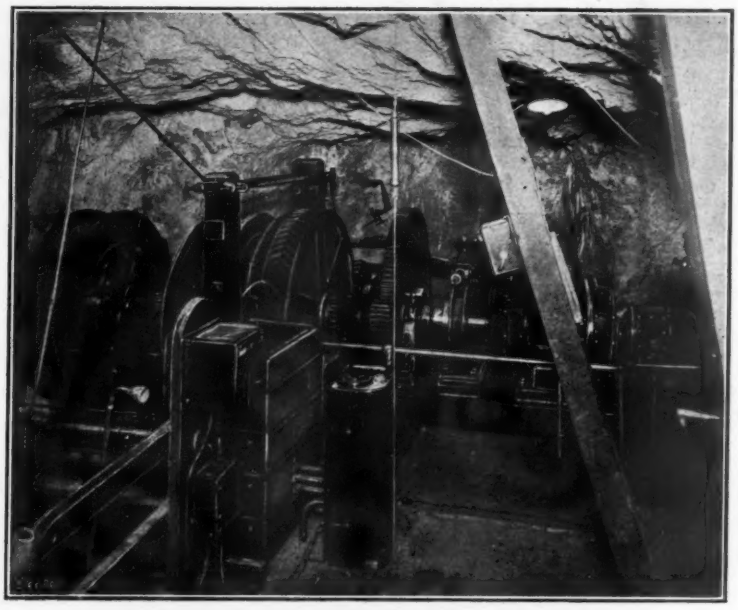


Fig. 5.—Underground Winder Equipment.

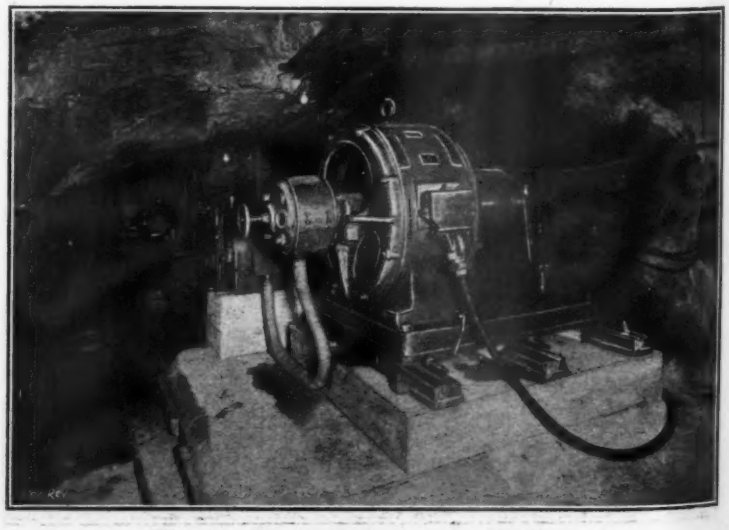


Fig. 6.—The New Air-Compressor Plant.

provided by the rotors of the alternators beyond what is necessary for their ordinary electrical and mechanical design. The buckets of the "Turgo" wheel are shrouded at their outer periphery, so that they guide the water more accurately in its passage through the wheel than is the case when unshrouded buckets are used. It is interesting to note that upwards of 150 "Turgo" sets have already been installed and are at work, and it is satisfactory that in a field in which many engineers and others regard the Continent as being pre-eminent, this new design has been developed entirely by a British firm.

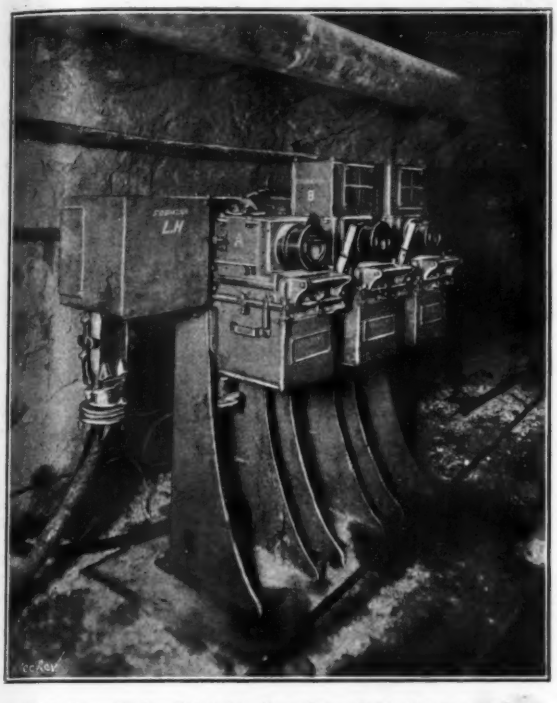


Fig. 7.—H.P. Distribution Board Underground.

Technical Data of "Turgo" Units.

Elec. output of alternator.	B.H.P. of waterwheel.	Speed r.p.m.	Working head in feet.	Date of manufacture
110 kW	170	750	430	1924
250 kW	370	1,000	430	1928

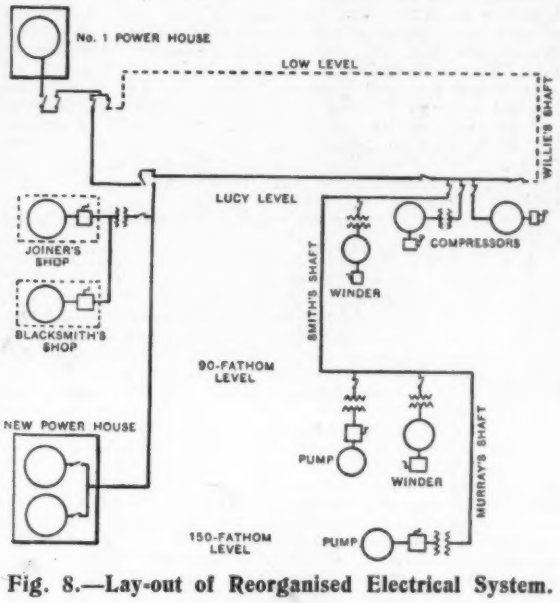


Fig. 8.—Lay-out of Reorganised Electrical System.

Electrical Accidents in Mines.

Extracts from the Report of H.M. Electrical Inspector of Mines for the Year 1928.

THE annual report of H.M. Electrical Inspector of Mines, Mr. J. A. Bernard Horsley, for the year 1928 is now available (H.M. Stationery Office, price 6d. net), and the following is a summary of its principal features. The number of mines at work during the year was 2,539 (322 less than in 1927). Electricity was used in 1,467 of them (61 less than in 1927). The horse-power of motors installed was, nevertheless, increased both above and below ground by 38,209 to 1,722,332, of which 824,672 h.p. was located above and 897,660 h.p. below ground. The h.p. of a.c. motors (all on 3-phase systems and mostly of the squirrel-cage type) represented 80.9 per cent. of the total.

Fatal Accidents Due to Electricity.

There were 15 fatal accidents attributable either directly or indirectly to the use of electricity, involving the loss of 19 lives and injury to 15 other persons. All of these fatal accidents occurred at collieries; three upon the surface works and twelve below ground. Ten of the accidents resulted in ten deaths by electric shock and minor injury to six persons, five in one accident. In another accident, death followed severe burns by the electric arc.

There were four instances of the ignition of firedamp, resulting in the death of eight persons and injury to nine others.

In three of the accidents from electric shock experienced electricians lost their lives while carrying out work in connection with main switchboards at high voltage; the work would not have involved any danger if suitable preliminary precautions had been taken. Preliminary earthing is a legal requirement, and this was pointed out in Mines Department Circular No. 23 published in 1927. In that circular a method was suggested, whereby the circuit could be earthed without risk to the operatoor. This suggestion, however, appears to have received little attention, except from manufacturers of switchgear.

The following cases have been selected from the report:—

Plymouth Colliery, Derby.—An electrician had found a loose outgoing cable connection in a 3-way link disconnecting box and this he proceeded to tighten, with a pair of pliers, after withdrawing the links for the incoming cable. The system was 3-phase at 520 volts with the neutral point earthed, so that the single-phase "shock" pressure was approximately 300 volts. Where such disconnecting boxes are used, the organisation should be directed to ensuring that they are not opened while the pressure is on.

Cambois Colliery, Northumberland.—A timberer was getting up floor to make height on a longwall face, cut by an electrically driven coal-cutting machine, when he struck the live trailing cable with his pick, making contact with one conductor, and received a shock that proved fatal. The system was 3-phase at 600 volts the neutral point being earthed, so that the single phase "shock" pressure was approximately 350 volts.

Motherwell Colliery, Lanark.—A conveyor man while at work with others moving a shaker conveyor forward on a machine-cut face, was killed by electric shock from a wire rope that he was pulling which became charged electrically, because some broken strands had pierced the sheathing of a trailing cable, thus making contact with one of the live conductors therein. The surplus cable had been coiled down on top of the wire rope, and when the frayed end of the rope reached the cable one or more of the sharp broken strands entered the cable, with the result that the cable and many of the conveyor pans became live. Five men besides deceased received severe shocks. The electrical system was 3-phase at 440 volts and the neutral point was earthed. The trailing cable was of the usual type and appeared to be in good working condition. This is another of the accidents due to conveyor shifting while coal cutting is in progress. It would be possible to reduce the risk by using a trailing cable of the type described generically by the term "ferflex," in which there is an earthed metal screen, or light armour, surrounding the live conductors, but a more direct remedy lies to hand in prohibiting simultaneous pan shifting and coal cutting.

Dewshill Colliery, Lanark.—A hole-borer, while preparing to use a small portable electric drill, received a shock, either from the metal-work of a small transformer or from an exposed end of some temporary connections thereto, which proved fatal. The drill motor was designed for 125 volts 3-phase current, which was furnished by a small transformer reducing from 500 volts. The transformer tank carried a 500-volt 3-pole fuse-switch, with a gland for an incoming armoured cable, and there was also an earthing terminal on the transformer.

Deceased, in the absence of an electrician, proceeded to remake a temporary connection to the plug, and it may have connected the earthing wire to one of the three live contact tubes in the plug. The effect would have been, the transformer tank being more or less insulated, to make the tank and the switch case mounted thereon "live," so that if deceased touched either of these parts, after switching on at the gate-end, he would receive a serious shock. It is possible, of course, that he touched the bare ends of the temporary wires. Apart from the lack of effective supervision the manner of making the temporary connection was unworkmanlike. A trailing cable could have been connected directly to the transformer switch with a plug at the other end to connect to the gate-end switch.

Bargoed Steam Coal Colliery, Monmouth.—An assistant electrician while cleaning and adjusting parts of a truck type switch panel, one of a number forming a main switchboard, appears to have slipped backwards into the cubicle from which it had been withdrawn and so to have come into contact accidentally with live parts which must have caused instant death. The system was 3-phase at 3,300 volts, and deceased appears to have made contact with more than one phase

A mechanical interlock to prevent withdrawal of the truck unless the isolating switches, or the floor below were open, was defective. The isolators were operated by rods and bevel and chain gearing, but this gear was also defective.

There was an order that work should not be begun upon the switchgear unless the corresponding isolator was open, but evidently no effective supervision. General Regulation 131 (*g*) requires that conductors before they are handled, and also adjacent conductors if there is any danger therefrom, as there was in this case, shall be discharged by earthing them.

This Regulation is specific and the need for structural alterations must be faced where such are necessary to enable the operatives to comply with this statutory requirement.

Grimthorpe Colliery, Yorkshire.—An assistant electrician, while cleaning insulators in a transformer chamber above ground, came into contact with, or induced a discharge from, the live terminals of an unrelated circuit housed in the same chamber and died from the effects of burns the next day.

The system was 3-phase at 23,000 volts, with the neutral point earthed.

The electrical apparatus involved comprised a modern switchboard of the cubicle type and in the rear thereof three chambers, each housing one large single-phase transformer, reducing the pressure from 23,000 to 3,300 volts for local use. Bare copper rod passing through the back wall connected the transformer terminals to the corresponding switchgear. One of the transformer chambers was also used to house the cable end, and the bare rod connections therefrom, of a circuit which supplied an electric winder at an adjacent pit. There were, therefore, two separate switches and sets of isolators which it would have been necessary to operate before the transformer chambers could be entered in safety. When deceased entered the third chamber and got upon the top of the transformer he was within easy reach of the bare rod connections to the winder cable, which were alive, and in some way an arcing discharge was brought about between one of the live rods and one of the isolated rods over a distance of approximately 20 in. There was evidence that the discharge had passed over one of the transformer insulators to the metal case. There was, apparently, a single-phase fault to earth and no circuit-breakers were tripped automatically. For the purpose of discharging the bare conductors a length of iron pipe was provided. There was no constructional provision in the switchgear to enable the transformer circuits or the winder circuit to be earthed as a preliminary to work upon them, and it was left to the discretion of the workmen to take any necessary precautions.

Backworth Maude Colliery, Northumberland.—A pan shifter was moving a shaker conveyor at the coal face while the coal-cutting machine was flitting along the face. They were actually sliding a section of the conveyor pan, which was upside down, diagonally across the live trailing cable when the right-angled sharp edges of the pan cut through the rubber sheath and insulation of the cable and made electrical contact with the live conductors.

Deceased fell upon the pan and succumbed, although he appeared to breathe heavily for a short time after 10 minutes and again 40 minutes later.

The electrical system was 3-phase at 650 volts, with the neutral point earthed.

Accidents of this type could be avoided either by arranging for effective supervision or, failing that, by prohibiting conveyor shifting while the coal cutting machine is at work.

Dewshill Colliery, Lanark.—A brusher had been assisting to clear coal from the face remaining over from the previous shift. An electrically-driven gate-end loader had been used. After the coal was all removed a Sylvester was attached to the loader to pull it back out of the way for brushing. There was an unarmoured flexible cable lying on the ground which carried the current to the loader, and when the machine had been withdrawn about 14 ft. one of the wheels passed over this cable, which had not been switched off, cutting into a live conductor, with the result that the Sylvester and the rails became live, the place being very wet. The electrical system was 3-phase at 550 volts, the neutral point being earthed. The earthing system appeared to be in order, but no fuses were blown.

Fauldhead Colliery, Dumfries.—A miner, while pushing a steel tub, ran over an unarmoured flexible cable that had been suspended across the track on nails driven into the head of a prop on each side of the track, with the result that the sheath and insulation were split and the tub or the rails, or both, became "live."

The cable was very insecurely held over the track and it had not been fastened in any way to the nails

The electrical system was 3-phase at 500 volts, and the neutral point was not earthed.

Glencraig Colliery, Fife.—An explosion occurred on starting a motor on a longwall face, which was cut by an electrically driven chain type coal-cutting machine. Seven men were burned, two of whom succumbed.

There was no difficulty in accounting for the ignition of firedamp, for the enclosure of the electrical parts of the coal-cutting machine was seriously defective. The motor was worked by direct current at 500 volts, on the concentric system, the components material to the issue being the plug, the starting switch, and the commutator. The plug and socket coupling of cylindrical pattern was not intrinsically defective, but it was indifferently attached to a bracket on the machine frame and was connected to the starting switch by a short length of cab tire sheath flexible cable, which passed through an unbushed hole in the ½-inch wall of the switch box, leaving an annular gap ranging from a minimum of 5/16 in., with the cable central, to a maximum of ⅝ in. with the cable touching one side of the hole. The original design included a bush for this opening. The door of the switch box consisted of a ¼-inch steel plate secured by 23 countersunk screws against a sheet of asbestos composition about ⅛ in. thick, which was broken away at a number of places, leaving openings into the switch box. Moreover, several of the screws were loose or ill-fitting. Similar defects in the fixing screws, and also the omission of screws, were observed in other cover plates enclosing, for example, the commutator and the bearing chamber, which was in communication with both the switch box and the commutator. The most extraordinary opening, however, was one that was not contemplated as a possible hazard by the designer. Owing to incorrect lacing of the haulage chain, two slots had been cut by the friction of the chain into the cheeks of the end frame of the machine. One of these opened a way into the switch box. Instead of passing the chain round the idler pulley it had been laced directly from the leading pulley to the driving pulley so that it bore hard upon the projecting parts of the frame. This machine had been subjected to an elaborate mechanical overhaul. The condition in which the enclosure of electrical parts had been left, after this overhaul, is only explicable upon the assumption that those responsible did not realise that the machine was to be used where firedamp might accumulate in dangerous quantity.

Auchengeich Colliery, Lanark.—An explosion occurred in a dummy road opening on to a point near the middle of a 200-yard longwall face worked with electrically driven coal-cutting machines and belt conveyors, whereby one man was killed outright, suffering fracture of the skull, and two others were injured.

The trailing cable for the machine was carried along the face and down the dummy road, about 40 ft., to a gate-end switch and fuse box.

It was found that a fall of roof and side had taken place near the brushing at the end of the dummy road upon the trailing cable, which had drawn the plug out of the switch box.

Although the machine men aver that the machine was not cutting at the time of the explosion, no other cause could be found than electricity, and it is assumed that a spark or arc at the plug, when it was withdrawn from the socket while carrying load current, ignited an accumulation of firedamp in the dummy road. The circuit was 3-phase at 500 volts.

There were two mechanical interlocks between the plug and the switch box. One consisted of a vertical spring-borne pin engaging with a recess in the face of the plug when depressed by closing the lid of the fuse box compartment. This interlock was effective, provided the plug was inserted fully. When examined *in situ* it was not found possible to insert the plug sufficiently far to engage the interlock.

The other interlock, a horizontal spring-borne rod, was designed to prevent the switch from being turned on except when the plug was fully inserted into the socket. This interlock was inoperative owing to a rusted bearing, so that the defect here contributed to the failure to observe or remedy the defect in the other interlock. There was also an interlock between switch and cover of this box which was broken.

The armoured roadway cable was brought into this gate-end box through an open gland, i.e., there was no bushing and the cable dividing box was not sealed with insulating compound, so that there was a ready opening for the entry of firedamp and for the passage of flame. In consequence of this explosion compressed air was substituted for electricity in this section.

(To be concluded.)

The Heat Pump.

A suggested Economical Method of Producing Low-grade Heat from Electricity.

By T. G. N. HALDANE, M.A., A.M.I.E.E.

(*Extracts from a paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

EVEN in the most efficient power stations wherein the conversion of the heat energy of coal into electrical energy is effected under the best possible conditions, the highest thermal efficiencies at present attained do not exceed about 25 per cent., and in consequence the cost per British thermal unit of electrical energy produced from fuel is generally high, compared with those of coal and, in most cases, of gas. For many purposes this high cost does not prevent the direct use of electricity as a heating agent, but when heat has to be supplied at ordinary temperatures and in large quantities, and extreme exactitude of regulation or ease of operation is not essential, it is much more difficult to justify its use. To a large extent this difficulty has been met by the cheap supply of electricity during off-peak periods at the bare operating cost, but unless coal can be obtained at a much cheaper price by the power station than by the consumer, *e.g.*, when low-grade coal can be used by the power station but not by the consumer, the economic difficulties are apt to be considerable. When coal is consumed in hot-water boilers the percentage generally does not exceed the 25 per cent. applying to electrical energy. In the case of gas the overall efficiency of heat supplied is about 50 to 65 per cent.

Because of these facts many people are of the opinion that electrical energy can never be used economically for producing large quantities of heat under ordinary conditions. That opinion is, of course, based on the assumption that the consumption of 1 kWh can at the best produce about 3,400 B.th.u. It may therefore surprise many electrical engineers to learn that this assumption is by no means justified. It is, in fact, possible to produce a very much larger number of B.th.u. by the consumption of this amount of electrical energy, provided it is converted first into mechanical energy and then used on the Carnot principle to pump heat from a low to a higher temperature. If we imagine a perfect reversible heat engine operating by taking heat from a source at a high temperature T_1 and rejecting it at a lower temperature T_2, so producing mechanical energy, the efficiency, *i.e.*, the ratio of the mechanical work produced to the mechanical equivalent of the heat taken in, is $(T_1-T_2)/T_1$. Carnot showed that this is the greatest possible efficiency of any type of heat engine working between these temperature limits. If we imagine the Carnot engine reversed (supplied with mechanical energy and made to pump heat from a low to a higher temperature) the heating efficiency* is $T_1/(T_1-T_2)$; therefore if (T_1-T_2) be small, compared with T_1, a small amount of mechanical work supplied will allow a very much larger amount of heat to be pumped from the one source to the other. In practice the source of the low-temperature heat T_2 would normally be the unlimited heat of the surroundings.

If heat is delivered at 100 deg. F. (560 deg. abs.) and taken in from the atmosphere at 40 deg. F. (500 deg. abs.) the efficiency is 9.33, *i.e.*, 560/(560−500). That is to say, for every B.th.u. of electrical energy put into the heat pump, 9.33 B.th.u. will be delivered at a temperature of 100 deg. F., and as each B.th.u. of electrical energy may have required the consumption of some 5 B.th.u. at the power station, the remarkable fact is revealed that it is at least theoretically possible for the consumer of the electrical energy produced at the generating station to obtain very considerably more heat than was required to produce the electrical energy which he consumes. In other words, there is economy in fuel consumption, as compared with direct conversion, if the fuel is first consumed in a power station, converted into electrical energy, and then used to produce heat by means of a heat pump. In the above example the economy is (9.33−5)/9.33=46.5 per cent., but it only exists if the heat required is comparatively low-grade, *i.e.*, low-temperature heat. The economy becomes greater as the temperature range is decreased, and reaches a very high value indeed when the range of temperature through which the heat is to be pumped is only a few degrees. The general principle of the above process was first pointed out by Lord Kelvin in 1852, and a description will be found in his "Collected Papers," Vol. 1, p. 515.

The reversible heat engine has so far been treated simply as a heat pump, the most familiar type of which is the refrigerator; its primary object is the production of cold rather than heat, but the two operations are complementary. The process of producing cold is simply that of pumping heat from a relatively cold to a relatively hot source, particular attention being paid to the prevention of leakage of heat into the cold source, whereas no attempt is made to prevent the escape of heat from the hot source. If treated as a heat pump in which the primary product is the heat rejected to the hot source, the order of importance would be reversed and every opportunity would be given for the leakage of heat into the cold source and every precaution taken to prevent leakage of heat from the hot source. Apart from this and minor differences in the temperature ranges over which the plant would work, a refrigerator is precisely the type of heat pump which, for the purposes of this paper, it is desired to consider.

The author shows both from theoretical considerations and from practical tests on refrigerating plant that, when heat at a comparatively low temperature is required, heating efficiencies of the order of from 300 to 500 per cent. or even more may be obtained.

The application of this principle to the heating of buildings and for such purposes as the heating of public baths is discussed, and estimated figures for a public-bath installation are given. The paper concludes with a description of experiments the author has been carrying out dring the past two years, which have demonstrated the soundness of the general principles on which the heat pump is based.

The system can be applied most favourably for central heating when (*a*) the heating system in the building is designed to operate at a comparatively low temperature, *e.g.*, panel heating; (*b*) plenty of water is available for the evaporator, *e.g.*, near a river or canal; an alternative to (*b*) would be the use of an air-heated evaporator, but its size and cost would, in general, be considerably greater.

An alternative method would be to supply heat directly to air blown into the building through a series of ducts. The air would be heated by passing over the hot condenser coils and the exhaust air would be sucked out by a fan and passed over the evaporator coils, where it would give up its heat before being passed out of the building. With this system it would probably be possible to work at lower temperatures than those assumed for the panel-heating hot-water system, with a corresponding gain in heating efficiency. Cross connections would enable the system to be reversed and the building cooled in hot weather, which could be effected more easily with the air-duct system suggested. Although in this country the periods during which it might be desirable to cool a building are comparatively short, there is no doubt that the possibility of such cooling would be a valuable asset. Any refrigeration which might be required if, for instance, the building were a large hotel could be supplied very simply. When comparing the heat pump with other methods allowance should be made for the possibility of combining the production of ice on a commercial scale, which would admit of very profitable use being made of the plant during the summer, when the more usual forms of heating apparatus are lying idle. In this way a large proportion of the capital charges of the installation might be paid.

The modern panel-heating system is peculiarly adapted for applying the heat pump to the central heating of buildings because it can be operated at a considerably lower temperature than that of the ordinary radiator system; it can, in fact, be operated with water supplied at temperatures between 110 and 120 deg. F., or possibly, with an increased amount of panel piping at temperatures even lower than this. It would not be difficult to avoid running the plant during the worst hour of peak load, so obtaining power at a comparatively low cost. With a heat pump the cost per 3,400 B.th.u. would be considerably less than the cost of a unit of electricity taken during off-peak hours. If, for instance, the cost of electricity taken during off-peak hours for a thermal-storage system were 0.25d. per unit and the corresponding cost of the heat-pump plant 0.5d. per unit, the cost of 3,412 B.th.u. supplied by the heat pump would be between 0.167d. and 0.125d., a reduction of from 30 to 50 per cent.

An ideal application is to the heating of swimming baths, normally at a temperature of between 70 and 80 deg. F.; not only would an extremely high heating efficiency be obtained, but also an ordinary type of refrigerating plant could be used with practically no modifications. In the case of one of the large London public baths, when allowance is made for the installation of 150 kW of stand-by immersion heaters and

* The term "heating efficiency," as applied to the heat pump, denotes the ratio, measured in hundreds per cent. of the heat produced to the heat equivalent of the electrical energy supplied. Although this is not the true efficiency from a thermodynamic point of view, it is the efficiency from the standpoint of this paper, *i.e.*, the production of heat by the consumption of electrical energy.

the waste water from the slipper baths is passed through the heat-pump evaporator, thus saving the bulk of the heat in that water, which would otherwise be lost, comparative figures are as follows:—

	Coal-fired	Electric
Total capital cost	£1,900	... £2,700
Total annual charge ...	1,822	... 1,290

The net annual saving (after allowing for capital charges) amounts to £532 per annum, or approximately 30 per cent. of the total annual cost of a coal-fired system.

As part of the experiments which the author has made, a small heat pump was installed in his home in Scotland and was used for domestic purposes. The compressor employed is a small ammonia machine manufactured for ordinary refrigerating purposes and electric power (unfortunately somewhat limited in amount) is obtained from a hydro-electric installation, which also supplies the cooking and lighting requirements of the house and power and lighting on two neighbouring farms. During the winter the plant has been used both to supply domestic hot water and for central heating; during the summer it has been run only at night to supply hot water for domestic purposes, and also to make ice. The latter is formed in the evaporator tank, on the surface of the coils immersed therein.

One of the main objects in installing this experimental plant was to obtain information about the general convenience of operation of such apparatus, and in many respects the information obtained on these points has been of more interest than the data relating to operating efficiency. Generally speaking, the author's experience is that the plant is extremely simple to operate and requires very little attention. Compared with any coal-fired central-heating apparatus, the heat pump has the very great advantage that it can be started in a few seconds, and can be shut down by the operation of an ordinary electric light switch. The adjustment of the expansion valve was the only operation involving some care, which has been obviated by means of an automatic valve which keeps the pressure in the evaporator constant at any required value.

In conclusion, the author does not suggest that the heat pump is always the most economical method of heating buildings. The object of the paper is to draw attention to its possibilities in order that, when conditions are favourable, this method of utilising electrical energy for heating may be used. It is probable that the heating of swimming baths is the most suitable field for the immediate application of the system.

The author acknowledges his indebtedness to Mr. L. Chew, of Messrs. L. Sterne and Co., without whose co-operation the experimental work could not have been carried out.

Electricity Supply in Russia.

Power station construction progress and an indication of the tota capacity available in the Soviet Union of Republics.*

IN the absence of precise details it is not easy to form an exact idea of the progress which is being made in the electricity supply industry in Soviet Russia. However, in a recent issue of "E.T.Z." (Berlin), Herr G. Dettmar, who lately spent five months in the country at the invitation of the Soviet Government, during which time he claims to have had opportunities of visiting the majority of the large power stations in the country, gives some information about the present position.

The author points out that, owing to the various commissions through whose hands they have to pass, considerable time elapses between the drawing up of plans for power stations and their actual construction and completion. First, there is the Glavelectro, the higher division of electricity, which is responsible for the drawing up of plans and their subsequent execution. All projects have next to be submitted to the Z.E.S., or central electrical committee, and then to the Gosplan, the commission which is concerned with the study of the general plan of Soviet Russian developments. Finally, all schemes are submitted to the Council of National Defence, the final decision being taken by the W.S.N.Ch., or the superior economic council.

Electricity supply stations are divided into three classes: (1) plant which is of interest to the whole Soviet Union; (2) stations which affect one or other of the various Republics of the Union; and (3) communal power stations. Of the first class there are twelve installations in operation, and ten in course of construction, while plans for a further twelve stations are included in the next five-year programme. Among the difficulties that have to be dealt with are the great distance the power has to be transmitted, the low density of population, and the fact that in many cases houses, &c., have to be built to form a village, or small town, near the site of the projected station. The geographical distribution of fuel supplies is, moreover, not very convenient. Perhaps the greatest difficulty in the carrying through of projected plant is the lack of the necessary capital. Hitherto, the Soviet Government authorities have refused to grant concessions to private undertakings for the construction and working of power stations, but, owing to the lack of financial resources, it has recently modified its policy to the extent that concessions may be granted in respect of eleven of the projected national installations.

From a total of 328,000 kW in 1913, the total capacity of the electricity generating stations in Russia increased to 702,000 kW in 1926, while at the beginning of October, 1928, there were eighteen large stations with a capacity of 522,000 kW and 642 small sets of plant totalling 320,000 kW in operation in the country. Petroleum is used as fuel in the majority of the power stations (34 per cent.), peat following with 24 per cent., coal 23 per cent., 13 per cent hydo-electric, and 6 per cent of a mixed character. Special attention is being devoted to the utilisation of peat for steam-raising purposes.

Herr Dettmar next deals with the electricity supply position in the various industrial districts. In the Moscow area there are four separate distribution systems, which will be retained until the completion of 30-, 50-, and 115-kV transmission lines which are in progress, and a projected 220-kV line. The city of Moscow, which has two million inhabitants, is supplied by the Union of Electrical Works, an undertaking comprising five stations with a total capacity of 255,000 kW, which is to be increased to 500,000 kW in 1931-32. A 300,000-kW station, to provide additional supplies for Moscow, is also to be erected near Bobriki, nearly 140 miles away.

In the Volga industrial area there are several new stations, including those at Nijni Novgorod, Jaroslaw, and Ivano-Wosnesensk. The Leningrad district is at present supplied by six stations, of which two are new, two old ones have recently been modernised, and two are eventually to be superseded. The total capacity is at present 167,000 kW, but is to be increased to 260,000 kW during 1931-32.

In the Ukraine district, which includes the Don coal-mining area, there are 35 power stations with a capacity of 228,000 kW, which is to be increased to 300,000 kW by 1931-32. In Caucasia, which is well situated as regards petroleum and gas supplies, as well as water power, two large generating stations are in operation, six in course of construction, and five are projected.

In the Ural area, which is rich in minerals of all kinds, two large power stations, one using coal and one peat, are at work and one in process of erection. In Siberia and Central Asia, while large sources of water power are available, the relatively small population is not favourable to its early development. The construction of four generating stations is, however, contemplated.

In addition to those mentioned above, there are over 600 small power stations in the country, as well as about 900 small sets of plants in agricultural districts, where the cost of generation is somewhat high.

The Soviet Government authorities are now devoting considerable attention to the rational and economical use of fuel. Only those industrial establishments which cannot take their supplies from the State-operated stations are allowed to establish their own plant, subject to the condition that the fuel is rationally used. Counting only plant of over 500 kW, authority has been given to 125, with a total capacity of about 700,000 kW. More than half of those stations are producing, or will produce when completed, not only electric power, but will also supply steam for heating and hot water for public use.

It is interesting to note the increasing use of high-pressure steam in Soviet Russia. There are 37 installations working at pressures of from 495 to 568 lb. per sq. in., and one, the Tege soap factory, is operating at 850 lb. per sq. in.

Finally, it may be mentioned that, according to the present plans, the electric power production capacity of Russia will, by 1933, amount to 2,650,000 kW.

* See also ELEC. REV., December 13th, 1929, pp. 1031 and 1040.

Naval Radio-telegraphy.

An Account of the Development of Apparatus for Naval Communication at Sea.

By G. SHEARING, B.Sc. M.I.E.E., and Capt. J. W. S. DORLING, R.N., M.I.E.E.

(*Extracts from a paper read before the* WIRELESS SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

WHILST spark and arc systems were mainly employed by ships at sea during the 1914-18 European war, to-day, except for special emergency purposes, spark transmitters are becoming obsolete and arc transmitters have been almost entirely replaced by valve transmitters in all types of ships, and now single valves are in use at sea which are capable of dissipating 8-10 kW at their anodes under oscillatory conditions. The high-power sets developed up to 1923 were long-wave transmitters for long-range working, but during this year long-range experiments at sea at frequencies above 3,000 kilocycles per second (100 m.) were commenced. Regular service routines employing short waves between England and naval ships and shore stations overseas have been in operation since 1926.

Apart from the direct application of wireless telegraphy to communication, the apparatus developed by H.M. Signal School at Portsmouth for distant control by the use of wireless signals of target ships is well known.

The requirements to be filled by a naval wireless telegraph system are that it must link up the ships of far-flung squadrons with their own commander-in-chief and with the Admiralty. The backbone consists of a series of naval shore stations situated in various British possessions throughout the world, in most cases forming a continuous chain of communication. All ships, down to destroyers, also use special low-power sets for fire control. The requirements of a naval wireless system are many and varied, and the overall efficiency of the Navy must depend largely on the efficiency of its wireless communications.

Typical office arrangements, apparatus design, and sea-going requirements are described and illustrated diagrammatically. Power is obtained from the ship's ring main through motor-generators, which are remote automatically-controlled, the auto-starters employed being so designed that they do not "throw off" under the normal vibration of the ship or shock from gun fire. The safety inter-lock circuits embrace the air blowers for valve cooling.

The types of telegraph transmitting circuit used are not discussed. The later designs employ master-oscillator types of generator circuits, the frequencies in certain cases (for the shorter waves) being stabilised by quartz-crystal control. The introduction of short-waves has modified the requirements very considerably. Their advantages for long-range working at distances from a few hundred miles up to world-wide ranges during certain portions of the 24 hours of each day are well known, and it has been necessary to arrange for the fitting of attachments to existing longer-wave sets capable of transmiting on a band of waves covering 4,300 to 21,500 kilocycles per second (70 to 14 m.).

The control stages are designed for operation on either long or short waves, and the main stage for short-wave operation comprises a high-frequency double-acting system of two valves which are neutrodyned to avoid retroaction; for long-wave working the valves are used in parallel. Signalling is obtained by grid-potential control. Switching arrangements are provided whereby the change from long-wave to short-wave working can be effected.

For shore station short-wave transmitters used for point-to-point working, quartz-crystal controlled transmitters are employed for frequencies of the order of 7,500 to 10,000 kilocycles per sec. (40 to 30 m.). In certain cases, frequency-doubler circuits are employed for transmission on the coresponding band of 15,000 to 20,000 kilocycles per sec. (20 to 15 m.), so that one crystal controls transmission on the two waves; the amplifier circuits are of high-frequency double-acting design, the third harmonic of the crystal frequency being selected and amplified. Automatic signalling is provided for by grid-potential control of one of the lower power stages, using a Creed relay. In the case of all naval ship transmitters, the circuit design is such that no spacing wave is transmitted and all ship transmitter have arrangements for listening-through.

The assembly and design of the components are a compromise between electrical and mechanical requirements, as the shock of gun fire causes the decks and bulkheads of the wireless telegraph offices in some ships to whip by as much as ½ in.

The fact that the main wireless telegraph office is usually situated below the main armoured deck has necessitated the fitting of special trunks whereby the high-frequency energy may be delivered to the main aerial with minimum loss and without danger to personnel. The trunk itself is of steel, in some cases copper-lined; recently a porcelain bowl-shaped insulator has been used with suitable fittings for securing it to the lower deck casting. The upper casting and the central cylindrical conductor are at the aerial high-frequency potential, the lining being an anti-brushing shield of spun copper fitted through the hole in the deck. The aerial feeder inside the trunk is a copper tube of about 2 in. diameter. The insulator itself is not of sufficient strength to withstand considerable pressure in an upright direction, and for this reason the steel trunk itself is designed to be a watertight structure. Two types of aerials have been employed, either: (i) sausage aerials having two or more legs, each comprising 10 wires on circular spreaders at about 1 ft. diameter, or (ii) flat roof aerials of about 6 or 8 single wires in parallel, arranged along yards of 30 to 40 ft. in length. There is very little difference in the communication, and the chief advantages of the flat roof over the circular-spreader type are the reduction of strain on the masts for a given aerial sag and windage, the greater ease of handling, and the reduction in cost. The run of the aerial feeders is of very great importance for efficient working. They must be set well clear of all obstructions and, especially, kept as far as possible from the tops of the funnels to avoid (*a*) reduction of effective height, and (*b*) the losses which otherwise may occur due to the low resistance from ionisation of the gases. On submarines provision has to be made for raising and lowering the main aerial, which is only employed for surface working, so that the mast is usually telescopic; for instantaneous working immediately after surfacing a smaller (fixed) aerial is employed.

The main receiving apparatus for heavy ships is installed in a "silent" room, which forms a portion of the main wireless telegraph office. It has been laid down as a general policy that all receiving instruments shall be operated independently of the ship's mains, and the power supplies for the anodes and filaments are for this reason taken from accumulators. The newer models employ dull-emitter valves with filament batteries of 4 volts; the anode batteries are usually limited to 50 volts owing to weight and space considerations, the receiving bays being supplied from a common anode battery *via* a cushioning unit to prevent interference. Experimental investigations are at present in hand with rectified alternating current and with d.c. generators as sources of supply (with or without a floating battery). Anode voltage for receivers does not appear to present any insuperable difficulties, but good regulation in a central receiving room when the filament current may be changed suddenly from 5 amperes to a few milli-amperes renders the problem much more difficult.

The wiring and arrangements of the receivers to reduce interference of many kinds has to be very carefully carried out; running machines are especially troublesome, and in this connection the importance of good workmanship in commutators and slip-rings in order to reduce sparking and ripple voltages cannot be over-emphasised.

Reception is over a band of from 12.5 to 6,000 kc/s (24,000 to 50 m.) and the requirement that the majority of naval receivers must be non-radiating necessitates an increase of circuit complications and in many cases increases the number of valves required for a given amplfication.

More recently the general policy of the design of receiving gear has been modified, the unit construction being departed from to a considerable extent. The later designs of amplifiers now include note-magnification and separate heterodyne in one unit, and in the case of reception on waves of the order of 600 m. and above special provision is made for multiple reception on one aerial. To cover the short-wave requirements two types of special tuner-amplifiers have been developed: a simple oscillating detector with two stages of note magnification, and an oscillatory detector preceded by a stage of high-frequency amplification to prevent oscillations from the detector reaching the aerial and being radiated; also, receivers have been developed employing a detector valve operating on the threshhold of oscillation in conjunction with a separate quenching valve. For automatic reception at shore stations, a special circuit has been developed using the double heterodyne principle. In ships, the fact that reception in general has to be carried out *via* cables or aerial trunks introduces difficulties due to the fact that for certain waves these may tune as transmission lines. The effects of this may usually be greatly reduced by the use of very loose aerial coupling, although loss of signal strength is thereby occasioned, especially in the case of interrupted-continuous-wave signals.

The apparatus has to be used in all climates, and, whilst every effort is made to reduce size and weight, instruments designed for use in H.M. ships are generally of more substantial construction than is considered necessary for shore work. A number of parts, components, and units which lend themselves to assembly in various ways for various purposes have been developed with a consequent saving in cost and in the time required for production. When the quantities required are large, mouldings, die castings, and stampings are stocked by the Admiralty and issued to contractors as required. In addition, commercially produced components which are standarised in the trade and suitable for the required purpose are used whenever possible.

Direction-finding has great tactical importance. The type of system fitted largely depends on the structure of the ship. As a general rule it is the practice to fit the Bellini-Tosi system, consisting of two loops in planes at right angles. Sometimes, however, where no suitable loops can be rigged, a rotating frame coil is fitted.

The responsibility for the experimental development and adaption of apparatus for naval communications rests with the Captain, H.M. Signal School, Portsmouth, where a staff of naval signal and civilian officers work side by side. The naval officers are attached to the Signal School for short periods only, usually two years, and in this way there is a continuous flow of officers from ships at sea who have intimate and up-to-date knowledge of performance at sea.

The director of the Signal Department, Admiralty, is in the closest touch in all signal matters with the Captain, H.M. Signal School, and is in direct touch with the Board of Admiralty; the reports from the various Commanders-in-Chief at sea are considered by the Director, and the policies to be adopted as a result of the reports are formulated by him after consultation with the Captain for the approval of the Board.

The experimental scientific staff of the Signal School is pooled under the Director of Scientific Research for the Admiralty, and a close liaison exists between the Signal School and the other Government and industrial organisations.

Following the production and satisfactory tests of first experimental models, first in the Signal School laboratories and then at sea, final designs and specifications for components are prepared and competitive tenders invited. The apparatus delivered by manufacturers is tested for acceptance by the Signal School, and is later installed in ships under the direction of Signal School fitting-out officers. B.E.S.A. standards are always adopted whenever possible, but proprietary articles are not usually embodied in designs for service use unless they are of sufficient outstanding merit to out-balance the disadvantages of dependence on one source of supply.

Alternating-current Potentiometers.

The Theory, Evolution, Accuracy, and Applications of such Instruments for Testing Purposes.

By C. V. DRYSDALE, O.B.E., D.Sc., F.R.S.E., M.I.E.E.

(*Extracts from a paper before the* METER & INSTRUMENT SECTION *of the* INSTITUTION OF ELECTRICAL ENGINEERS.)

NO department of electrical testing involves such difficulties and such costly equipment as that of accurate a.c. measurements. The great majority of a.c. and p.d. measuring instruments have only a limited range, owing to the square law which underlies their operation, so that to cover the range from, say, a few milliamperes to several thousand amperes, and from a few millivolts to 100 kV, a formidable array of such instruments is required, which is still further increased when polyphase circuits have to be dealt with and wattmeters have to be provided for power and phase measurements. The battery of costly instruments for covering the above requirements within an accuracy of 1/10th of 1 per cent. is beyond the resources of all but Government Departments and wealthy concerns: a single instrument which can deal with the situation, even at some sacrifice of convenience and accuracy, is certainly the greatest need of the instrument maker and smaller standardising laboratories.

The most universal of direct-current testing instruments is the potentiometer, first suggested in practical form by Sir Ambrose Fleming in 1885, and developed by Col. R. E. Crompton, which has persisted with only minor modifications to the present day.

Its great range and accuracy soon led to a desire for a similar instrument for a.c. testing, and various suggestions for transference devices to enable the alternating p.d. to be measured to be balanced against an equal continuous p.d. derived from the potentiometer were made. The "thermo-convertors" recently introduced by Dr. Moll, of Utrecht, would seem to be ideal for this purpose, as, owing to the large number of thermo-junctions employed, a temperature-rise in the heated wire of only a few degrees is amply sufficient, and they can be very accurately paired.

As early as 1891 Herr A. Franke conceived the principle which is now used in all a.c. potentiometers, namely, of balancing the alternating p.d. to be measured by a known alternating p.d., which can be varied both in magnitude and phase so as to reproduce the former exactly. His device consisted of two small alternators with a common revolving field magnet coupled to a driving motor, and has proved of great value in telephone and cable investigations.

Unfortunately the Franke device was little known in this country, and in 1908 the present author independently conceived the principle of considering the alternating p.d. as a vector, and balancing it both in magnitude and in phase by a similar p.d. derived from a potentiometer fed with alternating current from a phase-shifting transformer.

Reference is made to other forms of a.c. instruments that have since been devised. The first commercial potentiometer on the rectangular principle was introduced by Mr. D. C. Gall in 1923, who has recently produced a simplified portable self-contained model for approximate commercial tests. The latest in principle and one of the most simple was that devised by Dr. O. Pedersen in 1919, of the rectangular co-ordinate type. The a.c. potentiometer principle is also applicable to the measurement of h.f. up to radio frequencies, and a valuable start has been made in this direction by Messrs. B. S. & F. D. Smith, at the Admiralty Research Laboratory, with the polar type having a phase-shifting transformer. An ingenious valve a.c. potentiometer on the polar principle for frequencies up to 10,000 cycles per sec. has been devised by Mr. E. C. Wente, of the research laboratories of the American Telephone Co. and Western Electric Co.

The chief constructional features of the three principal types of a.c. potentiometers are dealt with:—The Drysdale-Tinsley instrument constructed by Messrs. H. Tinsley & Co., is divided into six sections: (*a*) the potentiometer, (*b*) the phase-shifting transformer, (*c*) the dynamometer current indicator, (*d*) the change-over switch for conversion from d.c. to a.c. working (*e*) the selector switch, and (*f*) the terminal slab. The potentiometer proper is a standard type of Tinsley universal potentiometer having two dials and a slide wire with transposition circuit, which the author considers to be the best compromise for accurate and rapid working.

The Gall co-ordinate instrument has the two potentiometers only contained in the case, the phase-splitting transformer and dynamometer being external; the potentiometers are of the Crompton single-dial and slide-wire type and the instrument, like the author's form, is constructed by Messrs. H. Tinsley & Co.

The Campbell-Larsen potentiometer has recently been put into commercial instrument form by the Cambridge Instrument Co., the potentiometer and variable mutual-inductance standard being in separate cases; this allows of the latter being detached for other uses.

Of all electrical instruments which have been devised, the a.c. potentiometer is by far the most universal in character, and its applications are so numerous that the author limits himself to a general account of them with detailed instructions and examples of only a few of the most important ones. It must be premised that, in common with other devices of a universal character, there is no pretension that the a.c. potentiometer is superior, or even equally accurate or convenient for any given test, to some of the special instruments, but it does allow of nearly all of these tests being made with ample accuracy for most practical purposes, with very little accessory apparatus. The bulk of the applications are described with reference to the author's polar potentiometer, as it is the only one with which he has had much experience; but the modifications necessary for the rectangular co-ordinate type of instrument will in most cases be obvious. All the ordinary d.c. potentiometer measurements can be made with the instrument.

On account of its universal character the author pays some attention to its first installation, especially as it is not readily portable, and lends itself to measurements on distant circuits. If it is once properly set up in a laboratory with the arrangements for various tests permanently arranged in different parts of the room, it will be found most useful; but it will be comparatively little used if it has to be specially set up for any particular test.

The paper, although admittedly most incomplete, should stimulate interest in a.c. potentiometers and help to give them their rightful place as the most valuable of all testing instruments, for both engineering and scientific testing. In view of the great need for such an instrument, it is remarkable that a.c. potentiometers have been so little used. Only three appear to be suited for general testing: the author's, the Campbell-Larsen, and the Gall forms. The author maintains the advantage of the polar principle for general purposes, but excellent work can be done by the Campbell and Gall instruments, and they have some advantages for measurements on circuits having either very low or very high power factors.

A review of the various tests described in the paper and consideration of the apparatus which would be required to cover them by the ordinary methods, show the saving of cost and time in equipping and testing to be too overwhelming to need any stress being laid upon it. The mere fact of being able to measure p.d.'s from a few microvolts to thousands of volts, and currents from fractions of a microampere to 40,000 amperes, either d.c. or a.c., from 25 to 2,000 cycles, to an accuracy of about 0.1 per cent. with the potentiometer and a set of volt boxes and mounts is in itself sufficient, without reckoning its application for phase measurements, inductance, capacity testing, &c.

New Electrical Devices, Fittings, and Plant

Readers are invited to submit particulars of new or improved devices and apparatus for publication in this section.

Universal Ball Joints.

A range of ball joints which find a wide application in the construction and operation of all kinds of machinery and apparatus is marketed in this country by Messrs. E. H. JONES (MACHINE TOOLS), LTD., Britannia Wharf, Baldwin Terrace, Islington, N.1. In use the joints are attached to the ends of shafts to take either power- or hand-operated motions through angles, or to allow lateral flexibility between driving and driven units. The single joints are designed to work at angles up to 45 deg., and the double joints up to 90 deg. Among their applications in the electrical and allied industries may be mentioned the connection from a control handle on a switchboard or starter panel to a remote part of the apparatus, the drive from a motor to a machine to take care of any mis-alignment between the two, or to allow the motor to be accommodated in an awkward position, and the synchronous drive from a motor of the projector and reproducer in "talkie" film apparatus. In the equipment of workships the joints also find many diverse applications. Fig. 1 shows the construction of the joints. The ball has four squared faces through which two holes are bored to take the pins of the two sets of links which join each half of the joint. The links are fitted in slots in the bodies A and held by pins, the whole being covered by sleeves B which are a forced fit and extend the length of the bodies. In the larger joints provision is made for constant lubrication from the hollow ball which is filled with oil through a hole in one of the links. The balls and links are hardened in order to leave a soft core to reduce the risk of fracture. The bodies of the joints are bored to standard sizes to take the shaft ends. Fourteen sizes of single joints with bores ranging from ¼ in. to 2 in. and nine sizes of double joints having bores from ⅜ in. to 2 in. are manufactured. Under test the joints have resisted a twisting movement of from 22 ft.-lb. in the smallest size, to 1,500 ft.-lb. in the largest size, without suffering any distortion.

Fig. 1.—Construction of "Werner" Ball Joint.

A Lampholder and Plug Unit.

A novel introduction of Messrs. W. E. BEARDSALL & Co., LTD., 5, Victoria Bridge, Manchester, is the "Xtra-Point" lampholder and plug, for which they are the sole selling agents. The device can be substituted for an ordinary lampholder and will, it is claimed, hang straight. The plug entries are inconspicuously placed in the upper part of the holder. it is made of good quality bakelite and has metal parts of ample carrying capacity. A cord-lock effectively separates the flexibles without compression, and is capable of suspending the weight of an adult. The plug takes the current direct to the heating appliance, and not *via* the lampholder plungers, so that there is no danger of the plunger springs, through overheating, losing their tension, with sticking of plungers and consequent arcing and burn-out. The plug is designed to carry 5 A without over heating, and if subjected to a violent tug it will leave the socket and not bring the pendant with it. The plug reversed will control either the light, the appliance, or both, and in position it does not foul or tilt the shade or holder. The apparatus offers an opportunity to the contractor of supplying a robust article to clients who cannot, or will not, afford wall-plugs in sufficient quantities, with considerably improved future prospects of supplying such essentials as irons, vacuum cleaners, bowl fires, and so on. A Home Office pattern, with a skirt, for use with portable tools in factories will shortly be ready, followed by an Edison-screw pattern. The holder is fully covered by patents both at home and abroad. Fig. 2 depicts the construction of the unit.

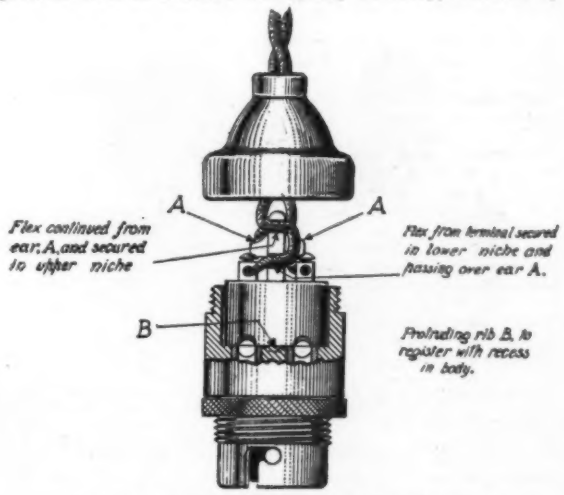

A
A
Flex continued from ear A and secured to upper niche
Flex from terminal secured in lower niche and passing over ear A.
B
Protruding rib B to register with recess in body.

Fig. 2.—Construction of "Xtra-Point" Lampholder.

New Three-Pin "B.S.S." Sockets and Plugs.

Messrs. J. H. TUCKER & Co., LTD., King's Road, Tyseley, Birmingham, have sent us a sample 5-ampere 3-pin plug and socket in a moulded "Telacite" case, as illustrated in fig. 3, complying with British Standard Specification Nos. 73 and 317. A particularly noteworthy feature is that the earth terminal is fitted to an elongated slot *inside* the cover of the socket, instead of on the outside as has been the practice hitherto with 3-pin B.S.S. sockets. The fixing of the earth terminal inside the socket entirely eliminates the possibility of consequential damage, while at the same time the earth terminal may be clearly seen through the elongated slot specially provided for this purpose, so that the socket complies with B.S.S. in respect of rule No. 317 "that the earth wire when in position must be visible." A feature which obviates for ever the troubles due to badly riveted or screwed parts is the provision of socket tubes and terminals in one piece. The spring slotted construction of the socket tubes also ensures a perfect and even contact over the entire surface of the plug pin. We understand that the practice of fixing the earth terminal inside the socket has also been

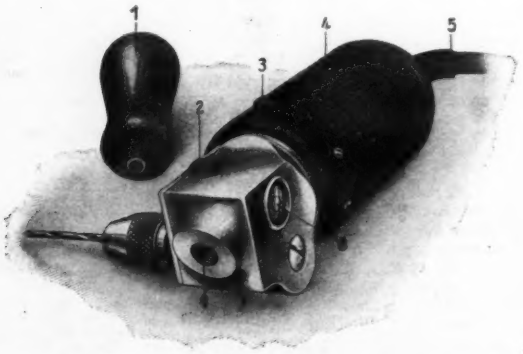
adopted in the 2- and 15-ampere sizes, every one of which in the circular pattern has the B.S.S. rating moulded on the cover. The three-pin plugs provided for use with the sockets are of the hand-shield pattern, and embody a special

Fig. 3.—Three-pin 5-A "Telacite" Socket.

cord-gripping arrangement which will accomodate any size of flexible or c.t.s. cable up to the capacity of the plug without alteration.

A Small Electric Hand Drill.

A recent introduction by the ELECTRICAL EQUIPMENT AND CARBON CO., LTD., Bank Buildings, 107 to 111, New Oxford Street, W.C.1, is the "Mignon" electric hand drilling machine, fig. 4, which is claimed to be the lightest electric drill yet made. It weighs only 2 lb., including the cables and plug. It is fitted with a universal motor with pendulum bearings, the motor being arranged in a casing made of rubber-free insulating material. The loading is only about 10 watts, so that the machine can be connected to any d.c. or a.c. lighting supply. The drill casing and chuck are also carefully insulated, thus ensuring the utmost safety. The gearbox is of substantial construction, and the drilling spindle runs in ball bearings and is drilled through longitudinally, so as to enable the use of drills of varying length. A precision three-jaw chuck is supplied with the machine of a capacity up to ¼ in. The drilling spindle is fitted with a



1, handgrip; 2, switch; 3, carbon brushes; 4, insulated motor housing; 5, cable connection; 6, screw socket for handgrips; 7, aluminium drill housing; 8, spirit level.

Fig. 4.—The "Mignon" Hand Drill.

tapered threaded sleeve which can be exchanged for a smaller or larger one, thus permitting the use of different drill chucks up to a capacity of 9/32 in.

The handle can be readily screwed off, a great advantage when drilling in inaccessible places, and for transport.

A High Precision Voltmeter.

The development of a precision voltmeter, which will measure alternating voltage between 20 and 300 volts with an error of only 0.01 per cent., is announced by the United States Bureau of Standards. In any ordinary instrument of the deflecting type a small error is introduced into the readings, because the springs used in the mechanism are not perfectly elastic. In the instrument designed by the Bureau this error has been suppressed, and an optical magnifying system is used which is equivalent to a pointer more than 60 ft. long. Thus, very small deflections are easily read with high precision.—*Telegraph and Telephone Age.*

Swiss Railway Electrification Programme.

The sections of the Swiss Federal Railways to be electrified in Western Switzerland are as follows:—Neuchâtel-Chaux-de-Fonds-Col des Roches, 1930-31; Délémont-Bâle & Délémont-Delle, 1931-1932; Bienne-Sonceboz-La Chaux-de-Fonds, 1932-1933; Berne-Lucerne, 1933-1934; Neuchâtel-Les Verrières, 1934-1935; Sonceboz-Moutier, 1935-1936; in the year last stated the electrification of Giubiasco-Lugano is to be put in hand.

Legal.

Ogilvy v. Dundee Corporation.

IN Dundee Sheriff Court on December 12th Sheriff Malcolm heard agents in an action at the instance of Sir Herbert Ogilvy, Bt., Baldovan, against Dundee Corporation regarding a supply of electricity to premises connected with a bleach field on the estate. For the Town Council, the Depute Town Clerk pointed out that the premises were beyond the burgh of Dundee, and so far as the supply of electricity was concerned the Electricity Committee were not the undertakers. The suppliers beyond the burgh boundary were the Grampian Electric Supply Co. For Sir Herbert Ogilvy it was contended that although the premises were outside the burgh boundary the Corporation was bound to supply electricity because of agreements come to in 1907 and in 1914 by which it undertook the supply of electricity at the plaintiff's request. The particular part of the estate in which the bleach field was situated was outside the supply area of Baldovan estate, as specified in the 1914 Act. An agent for Sir Herbert said it was true that the proprietor had asked the Grampian Supply Co. if it was in a position to supply him, and the reply was that it was not able to do so. The agent pleaded that the supply of electricity was a matter of real urgency as a firm had been in occupancy for two months and had had to close down daily at 3 p.m. because of the want of artificial light. His Lordship reserved judgment.

Gibson and Another v. Hull Corporation.

IN the Chancery Division on December 19th, Mr. PRESTON, K.C., applied to Mr. Justice Farwell for an injunction restraining the Hull Corporation from discharging 115 employés of the Tramway Department who were taken on during the general strike of 1926. He explained that the action was being taken by two of the men concerned on behalf of them all.

Mr. WILFRID HUNT, for the Corporation, said that his clients had already decided not to act upon their resolution to discharge the men until the end of January or February.

Mr. PRESTON said that he was not prepared to accept a statement made on behalf of the Corporation, but he would accept an undertaking to the effect that notices would not be given to the men before January 17th.

This undertaking was made, and the motion was adjourned until the next sittings

Correspondence.

Correspondents should forward their communications* as early as possible.** ***No letter can be published unless we have the writer's name and address in our possession.

The Thawing of Water-pipes.

In your issue of December 20th you publish a few notes concerning the thawing of water-pipes by electricity, and mention that a truly practical method was only available during the first three months of the present year.

It is obvious that you were not aware of the earlier "practical method" of coping with frost conditions which has been available and directly applied for at least seven or eight years now by a German firm of transformer makers. It was they who made the process practical by connecting the terminals of the secondary of a transformer to two solid clamps, which are placed a proper distance apart, direct on to the water pipe, thus producing the necessary amount of warming. In the case of the largest of these house transformers, namely, 200 watts, the secondary current is somewhat in the neighbourhood of 40 amps. at 5 volts, and this has been found to be quite sufficient to deal with the average requirements of small houses.

A. W. Isenthal,
Managing Director,
ISENTHAL & CO., LTD.

London, W.3. *December 19th,* 1929.

[We are interested to receive particulars of the German transformer. Our correspondent in Switzerland referred only to conditions prevailing in that country.—EDS. ELEC. REV.]

The All-electric House.

I think your correspondent Mr. W. T. Wardale has, by his letter, earned the gratitude of the electrical profession on the question of the all-electric house. After the cold water douche of your correspondent, Mr. F. J. Moffett, it is a real tonic to read a letter from an electrical man who, first, does believe in his calling, and, secondly, actually puts his belief into practice, which is more important still.

After all, what can we expect of the public if it be found that electrical men themselves are half-hearted in the practice of their profession? It surely is time that electrical men as a whole started to boost their profession as one of the finest propositions on earth, and to tell the public that "the all-electric house" is inevitable on the score of efficiency, convenience, cleanliness, and economy. Mr. Wardale's letter, in my opinion, should be reprinted as a circular letter, posted up in every electrical man's home, and pinned to every electrical contractor's office table as a practical reminder that electricity is a real live proposition to the community at large.

I sometimes wonder whether the average electrical contractor is yet properly converted to the uses of electricity even in the year 1929, as I have heard one speak of electric heating and cooking with bated breath, and even counsel his staff not to say "too much about it."

No wonder the progress of electricity in this country is blocked when such men damn it with faint praise.

In fact it sometimes appears to me that a society for the conversion of electrical contractors would do a great deal of good in the electrical world.

Whatever may or may not be said about coal, coke, or gas applications to domestic use, it is an indisputable fact that electricity is absolutely pure heat in every way, and cannot be adulterated or chemically played with in any respect. Congratulations to Mr. Wardle for the tonic which should raise the voltage and increase the ampereage of every electrical man in the kingdom.

Hubert W. Haydon,
Managing Director,
RADIA ELECTRIC CO. (GLOUCESTER), LTD.
Gloucester, *December 16th*, 1929.

Standardisation of Sizes of Advertisement Pages.

I am in entire agreement with the letter under the above heading which appeared in your issue of November 29th last. Variations in page sizes are not only expensive, but also extremely inconvenient to the advertiser.

The additional expense involved in having special drawings and blocks made for certain papers is quite a considerable item in proportion to the total cost of buying and filling space in these papers. It seems absurd that one should have to spend possibly £4 to £5 on a revised drawing and new original half-tone block to occupy space which itself costs no more than that amount of money. Yet this is a very common experience of advertisers in technical and trade papers.

At present, probably 60 or 70 per cent. of the trade and technical papers can use a block measuring 10 in.×7 in., although in a number of these cases this can only be done by allowing extra white space round the advertisements. Of the remaining 30 per cent. or 40 per cent., perhaps half can use blocks made in the same proportion as 10 in.×7 in., while for the other half, one has to have special drawings made.

Standardisation of page size *must* come sooner or later. Individual papers will, of course, have their individual and peculiar difficulties to surmount in adopting a standard page size. Time, however, will not lessen these difficulties, but will tend rather to accentuate them.

Any objections which may be raised now by a particular paper will be still more cogent in five or ten years' time. Every month and every year of further delay in this vital matter means additional trouble and expense when the change is finally made.

H. E. Goody,
Advertising Dept.,
BRITISH THOMSON-HOUSTON CO., LTD.
London, W.C.2, *December 16th*, 1929.

Published Specifications.

Compiled expressly for this journal by a firm of Chartered Patent Agents. The numbers in parentheses are those under which the specifications will be printed and abridged and all subsequent proceedings taken.

1928.

15,656. "Apparatus for regulating voltage in alternating-current distribution systems." Ganz-Fele Villamossagi Reszvenytarsasag. May 28th, 1927. (291,101.)

15,905. "System of railway control and signalling." J. Neale. May 31st, 1928. (Cognate applications, 17,662/28, 20,956/28, 31,341/28, and 32,708/28.) (322,197.)

16,009. "Apparatus for regulating voltage in alternating-current distribution systems." Ganz-Fele Villamossagi Reszvenytarsasag. June 1st, 1928. (Addition to 291,101.) (322,199.)

16,178. "Process for the manufacture of glass transparent to ultra-violet rays." Soc. Anon. des Manufactures des Glaces et Produits Chimiques de Saint-Gobain, Chauny, et Cirey. June 4th, 1927. (291,468.)

16,278. "Process and apparatus for the electrolytic removal of metal from metallic bodies." S. O. Cowper-Coles. June 5th, 1928. (322,118.)

21,116. "Process and apparatus for the separation of visible rays from ultra-violet rays by filtration." . . Y. Johnson (I. G. Farbenindustrie Akt. Ges.). July 20th, 1928. (322,200.)

21,344. "Blocks for switches, ceiling roses, and other electrical fittings." J. J. Brewer and F. F. Brewer. July 23rd, 1928. (322,159.)

21,585. "Electric furnaces." A. E. White (J. J. Naugle). July 26th, 1928. (322,160.)

24,074. "Device for preventing the unauthorised use of electric switches." Pennant Manufacturing Co., Ltd., and A. D. Arter. August 21st, 1928. (322,171.)

24,417. "Electric switches for motor vehicles." M. Charles. September 27th, 1927. (297,769.)

24,488. "Electrical insulating materials." W. S. Smith, H. J. Garnett, J. N. Dean, H. C. Channon, W. Gardner, and H. F. Wilson. August 25th, 1928. (Cognate applications, 29,345/28 and 4,613/29.) (322,208.)

24,613. "Apparatus for the production of sounds and the reception of wireless signals." M. J. Goldberg & Soehne Ges. August 27th, 1927. (Addition to 244,133.) (296,311.)

24,639. "Incandescent electric tubes." H. Hartman. August 26th, 1927. (296,315.)

24,823. "Call-finders for automatic and semi-automatic telephone systems." Standard Telephones and Cables, Ltd., E. P. G. Wright, J. H. E. Baker, and A. H. Cameron. August 29th, 1928. (322,190.)

24,850. "Telephone apparatus for transmitting and/or reproducing audible signals." S. L. Price. August 29th, 1928. (322,192.)

25,111. "Photo-electric cells and circuits therefor." G. M. Wright and S. B. Smith. August 31st, 1928. (322,235.)

25,462. "Automatic or semi-automatic telephone systems." Standard Telephones and Cables, Ltd., and E. P. G. Wright. September 5th, 1928. (322,239.)

25,463. "Power cables." Standard Telephones and Cables, Ltd., and J. K. Webb. September 5th, 1928. (322,240.)

25,464. "Automatic and semi-automatic telephone exchange systems." Standard Telephones and Cables, Ltd., and E. P. G. Wright. September 5th, 1928. (322,241.)

25,483. "Telephone systems." Automatic Telephone Manufacturing Co., Ltd., W. H. Paulett, and C. Gillings. September 5th, 1928. (322,242.)

25,519. "Feeder distribution boxes particularly for wireless aerials." J. Brown. September 5th, 1928. (322,244.)

25,646. "Galvanic batteries." L. Fuller and G. J. A. Fuller. September 6th, 1928. (322,251.)

26,499. "Light signals for controlling railway and other traffic." British Power Railway Signal Co., Ltd., and E. C. Irving. September 15th, 1928. (Cognate application, 32,730/28.) (322,262.)

27,188. "Electric cigar or the like lighter." Schoeller & Co. Elektro-Technische Fabrik Ges. September 21st, 1927. (297,442.)

27,931. "Radio valve circuits." Igranic Electric Co., Ltd., and A. D. A. Hodgson. September 28th, 1928. (322,271.)

29,115. "Electrolytic production of protective coatings of peroxide of lead on electrical conductors." Siemens & Halske Akt. Ges. October 22nd, 1927. (299,306.)

29,384. "Transformer coils, particularly for wireless receiving apparatus." Brandes, Ltd., T. D. Ward-Miller, and A. K. Paterson. October 11th, 1928. (322,283.)

29,360. "Electric batteries." E. P. Griffin and W. A. Buckley. October 11th, 1928. (322,285.)

29,700. "Electric power apparatus for dairy farms." General Electric Co., Ltd., and W. P. Gauvain. October 15th, 1928. (322,288.)

29,968. "Electric blasting fuses." J. Schurmann and Fabrik Elektrischer Zunder Ges. October 17th, 1928. (322,290.)

30,866. "Electrical amplifying arrangements." S. G. S. Dicker (Naamlooze Vennootschap Philips' Gloeilampenfabrieke). October 24th, 1928. (322,294.)

31,052. "Electric incandescent lamps or similar articles." Westinghouse Lamp Co. October 31st, 1927. (299,780.)

31,240. "Tramway and other vehicle brakes." Electro-Mechanical Brake Co., Ltd., and L. A. Catlin. October 27th, 1928. (Cognate application, 6,262/29.) (322,298.)

31,335. "Vacuum electric tube devices." Westinghouse Lamp Co. October 27th, 1927. (299,847.)

31,365. "Sound-emitting apparatus." J. Pintsch Akt. Ges. November 2nd, 1927. (299,841.)

31,722. "Sparking plugs of internal-combustion engines." F. L. Brown. November 1st, 1928. (322,301.)

32,961. "Electric contact breakers." British Thomson-Houston Co., Ltd., A. P. Young, and L. Griffiths. November 10th, 1928. (322,308.)

32,962. "Electric contact breakers." British Thomson-Houston Co., Ltd., A. P. Young, and L. Griffiths. November 10th, 1928. (322,309.)

33,006. "Horns and trumpets for talking machines, loud-speakers, and like instruments." J. G. Coombs. February 21st, 1928. (306,475.)

33,459. "Electrical apparatus." General Electric Co., Ltd., and J. P. S. Pillans. November 15th, 1928. (322,316.)

34,915. "Construction of direction and movement indicator for motor road vehicles." S. S. Warshawer and A. Posner. November 27th, 1928. (322,334.)

36,275. "Constant-speed multi-frequency electrical generating apparatus." W. Dornig. December 8th, 1928. (322,347.)

36,954. "Switch mechanisms as used in automatic telephone and like selective systems." Siemens Bros. & Co., Ltd., and O. A. Christian. December 14th, 1928. (322,356.)

36,989. "Electrical frequency changers." British Thomson-Houston Co. Ltd. December 23rd, 1927. (302,904.)

37,473. "Cooling arrangements of enclosed dynamo-electric machines." W. McGee & Son, Ltd., and G. S. Young. December 19th, 1928. (322,363.)

37,831. "Arrangement for exciting synchronous machines." Siemens Schuckertwerke Akt. Ges. December 23rd, 1927. (302,931.)

38,093. "Electric furnaces." F. B. Woolford. December 24th, 1928. (322,367.)

38,344. "Rapidly-producing uniform metal deposits electrolytically." K. Breusing and U. Gottesmann. December 28th, 1928. (322,371.)

1929.

255. "Transmission of pictures." British Thomson-Houston Co., Ltd. January 23rd, 1928. (304,653.)

1,381. "Electric lamps." F. Farrant. January 15th, 1929. (322,382.)

2,010. "Thermally-responsive electric switches." Associated Electrical Industries, Ltd. January 25th, 1928. (304,724.)

2,757. "Electrical measuring instruments." C. D. Sutton and Cambridge Instrument Co., Ltd. January 26th, 1929. (322,386.)

4,426. "Apparatus for the transmission or reception of ultra-short waves." C. Lorenz Akt. Ges. May 12th, 1928. (311,395.)

4,948. "Dynamometer apparatus for testing internal combustion engines." F. W. Highfield and Highfield Electrical Co., Ltd. February 14th, 1929. (322,394.)

5,641. "Radio-communication systems and the like." Marconi's Wireless Telegraph Co., Ltd. February 20th, 1928. (306,460.)

5,920. "Electrically-heated smoothing irons." Soc. Anon. Calor and L. Trouilhet. February 22nd, 1929. (322,403.)

6,841. "Disk-shaped electro-motors." J. Salomon. February 19th, 1929. (322,409.)

12,020. "Illuminating bodies with concave reflector and diffusely radiating incandescent bulb." C. Zeiss. May 10th, 1928. (311,370.)

12,217. "Telegraph concentrators." Associated Telephone and Telegraph Co. April 30th, 1928. (310,900.)

12,723. "Indirect-lighting system for apartment and for other uses." J. T. Dourgnon. April 25th, 1928. (310,420.)

16,428. "Holder for electric incandescent lamps." K. Geyer and F. Ulbrych. May 28th, 1929. (322,423.)

22,763. "Combined motion-picture and sound-reproducing apparatus." W. E. Beatty (Bell Telephone Laboratories, Inc.). July 20th, 1928. (Divided application on 321,148.) (322,233.)

22,764. "Combined motion-picture and sound-reproducing apparatus." W. E. Beatty (Bell Telephone Laboratories, Inc.). July 20th, 1928. (Divided application on 321,148.) (322,234.)

31,496. "Magnetic clutches." A. K. Croad (Sand Spun Patents Corporation). July 27th, 1928. (Divided application on 321,158.) (322,161.)

Trade Mark Applications.

THE following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from December 18th:—

Hum-Dinger. No. 503,668. Class 8. Fixed and variable electrical resistances.—Claude Lyon, Ltd., 76, Old Hall Street, Liverpool.

Gramplifier. No. 507,160. Class 8. Philosophical and scientific instruments and apparatus for useful purposes.—H. E. Du Prè, 42, King Street, Jersey. (London representatives: B. J. Wildbore & Son, 101, Leadenhall Street, E.C.3.)

His Master's Voice (lettering and design). No. 507,193. Class 8. Television apparatus and parts thereof, &c.—Gramophone Co., Ltd., Hayes, Middlesex.

Chromolox. No. 498,282. Class 13. Electrical immersion heaters, and heating devices in the form of strips and rings, being part of electric heating apparatus.—Geo. Bray & Co., Ltd., Leicester Place, Leeds.

New Work for Contractors.

Particulars of new works and building schemes for the use of electrical installation contractors in search of work and all interested in the sale of electrical and allied plant and other products.

Publication in this list is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

ABINGDON.—Housing scheme (50), for the T.C.; borough surveyor.

BECKENHAM.—Municipal buildings (£83,000), for the U.D.C.; surveyor.

BIRKENHEAD.—Elementary school, The Dell, Rock Ferry; R. W. Johnston, architect to the E.C., Town Hall.

BLANDFORD.— R.C. church; Rev. Father O'Byrne, resident priest.

BRENTFORD.—School, Boston Road, for the U.D.C.; E. Willis, Town Hall, Chiswick (returnable deposit of £33s.)

BURTON-ON-TRENT.—Housing scheme (34), Gordon Street, for the T.C.: borough surveyor.

CANTERBURY.—Development of Hales Place estate, with 100 houses, for Mr. Thomas.

CARLTON (NOTTS.).—Church; Rector of Sacred Heart R.C. Church.

COLCHESTER.—Housing scheme (25 acres), Harwich Road; borough engineer. Extensions, biscuit factory, North Station Road; D. J. McPherson, Burton. Extensions to saw mills, Military Road; Groom, Daniels & Co., Ltd.

CREWE.—Additional 45 houses for the T.C.; L. Reeves, borough architect.

DERBY.—Re-erection of confectionery factory, Chequers Lane, electrically equipped, for William Addey & Sons.

DORCHESTER.—Elementary school, Queen's Avenue; Dorset county architect.

DUMFRIES.—Waterworks (£17,000); burgh waterworks engineer.

EDINBURGH.—Houses (84), for the Corporation. Extensions to city chambers; city architect.

FOLKSTONE.—School, for the Catholic managers; Monsignor Coote.

GLOSSOP.—Lodge and office at Poor Law Institution; Board of Guardians..

GOOLE.—School; education officer, County Hall, Wakefield. Municipal offices; surveyor to U.D.C.

GOUROCK.—Conversion of Pavilion picture house into roller skating rink; the manager.

GUISELEY.—Adaptation of engineering works to swimming baths, for the U.D.C. (£6,000).

HAMILTON.—Housing scheme (270), for the T.C.; burgh surveyor. Cinema for Associated British Cinemas; the secretary.

HASTINGS.—Houses (50), Broomgrove estate. Front improvement, with underground parking station, electric lifts, &c. (£110,000); borough engineer. Fire station (£17,000), for the T.C.; borough surveyor.

HEREFORD.—Housing scheme (40), for the T.C.; Bettington and Son, architects, Palace Chambers (returnable deposit of £2 2s.).

HUDDERSFIELD.—Houses (48), Lowerhouses estate, Almondbury; borough architect, 26, Ramsden Street.

IRISH FREE STATE (WEXFORD).—Reconstruction of courthouse and county office, for the Wexford County Council; W. F. Barry, county surveyor (returnable deposit of £5 5s.).

KIDDERMINSTER.—Housing scheme (86), for the T.C.; borough surveyor.

LEAMINGTON.—School; secretary to the E.C.

LEICESTER.—Housing scheme (100); Leicester Housing Voluntary Association.

LEIGH-ON-SEA.—Proposed St. Margaret's Church; vicar.

LITTLEPORT.—Senior school (320 places); Isle of Ely E.C.

LONDON (EAST HAM, E.).—Houses (100), Claremont Road; borough engineer.

(WOODFORD, E.).—Buildings M.W.B. pumping station (£14,229); F. R. Hipperson & Son.

(FINSBURY, N.).—Tenements, Royley Street (£14,000); borough engineer.

(ST. PANCRAS, N.W.).—Blocks of flats adjoining Cumberland Market; Commissioners of Crown Lands.

LONDON (*continued*).

(HENDON, N.W.).—Shops, L.C.C. Watling estate; R. F. Yeo. Baptist church; trustees.

(GREENWICH, S.E.).—Houses (79) at Charlton Park estate, for B.C.; borough engineer, Royal Hill (returnable deposit of £2 2s.).

(DULWICH, S.E.).—Flats (757) in five-storey blocks, Dog Kennel Hill; L.C.C. architect.

(BALHAM, S.W.).—Five blocks of flats, Beeches Road; Swain and Selley.

LOUTH.—Housing scheme (32), for the T.C.; borough surveyor. Boys' school, for the Governors of King Edward VI Grammar School (£18,329); B. Pumfrey, Ltd., Gainsborough.

LOWESTOFT.—Elementary school, Church Road, for the E.C.

MANCHESTER.—Bank premises, King Street, for Midland Bank, Ltd.

MIDLOTHIAN.—Extension of Currie School (£18,000); Master of Works, Midlothian Education Authority, Edinburgh.

MITCHAM.—Houses (360), Mitcham Road estate; Croydon borough engineer.

NANTWICH.—Housing scheme (60), for the U.D.C.; P. H. Paton, surveyor (returnable deposit of £2 2s.).

OTLEY.—Alterations and additions to White Hart Hotel, for Tadcaster Brewery Co., Ltd.; Garside & Pennington, architects, Pontefract.

RAINHAM (ROMFORD).—Church, for the Wesleyan trustees; J. H. Broadbent, architect.

RAWMARSH.—Housing scheme (100), Ryecroft estate, for the U.D.C.; J. A. Tonge, architect, Council Offices, Parkgate, Yorks (returnable deposit of £2).

RIPON.—Slum clearance; city engineer.

ST. HELENS.—Houses (92), for the T.C.; Chappel & Sons, Ltd., builders, Swinton, Manchester.

SALFORD.—Municipal offices; city architect. Extension of works, Greengate, for Greengate & Irwell Rubber Co.

SETTLE.—Sewage disposal works, including engine house, sludge pumps, &c.; F. J. Rodwell, engineer, 37 & 38, Prudential Buildings, Park Row, Leeds (deposit £3 3s.).

SHEFFIELD.—Housing scheme (88), Wybourn estate; W. G. Davies, city architect (deposit £2 2s.).

SHIPLEY.—Extensions to textile shed, Shipley Technical School; education officer, County Hall, Wakefield.

SHOTLEY BRIDGE.—Methodist church and schools; trustees.

SITTINGBOURNE.—Electric lighting installation, Town Hall, for the U.D.C.; clerk.

SOLIHULL.—Restoration of parish church (£20,000); Rev. C. O. R. Wormald, rector.

STALYBRIDGE.—Houses, Darnton Road; Swallow & Taylor.

SURBITON.—Library and fire station, for the U.D.C.; Joseph Hill, architect, Southborough House. R.C. church, Thornhall Road; Rector of St. Raphael's, Kingston-on-Thames.

SWANSEA.—Houses (1,500) and flats (100). School (480 places), Baptist Well (£16,500); borough architect. Branch library, Oystermouth; librarian. Waterworks; Sir Alexander Binney, Son & Deacon.

TRURO.—Extensions, Royal Cornwall Infirmary; Cowell, Drewit & Wheatly, architects, Mansion House,

TYNEMOUTH.—Extensions to canning factory, Brewers Bank, for Shields Ice & Cold Storage Co., Ltd.; A. K. Tasker, architect.

WHITEHAVEN.—Houses (82), for the T.C.; borough surveyor.

WOKING.—Baptist church, Kingfield; Thomas & Jones, architects, Swansea; Norris & Co., Ltd., builders, Sunningdale.

WOLVERHAMPTON.—Employment exchange, for H.M. Office of Works, King Charles Street, London, S.W.

WREXHAM.—Housing scheme (160), with electrical work, for the R.D.C.; J. Herbert Edwards, engineer, Imperial Buildings (returnable deposit of £10).

JAN 9 1930

The ELECTRICAL REVIEW

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Advertisement Index, see page xliv. *Official Notices, see Sup. 30.*

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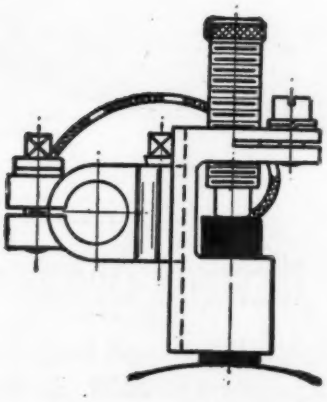

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BERTRAM THOMAS

Electrical and Mechanical Engineer and Contractor.
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SWITCHBOARDS, SWITCHES, CIRCUIT-BREAKERS. AUTOMATIC STARTERS, VOLTAGE REGULATORS, BATTERY SWITCHES. DYNAMO AND MOTOR REPAIRS. PATENT STEEL SHELVING, Adjustable and Sectional. "TILTRACK" PATENT STORAGE SYSTEM.

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A GOOD LAMP WITH A GOOD NAME

Sell the 5-size line: 15, 25, 40, 60 and 100 watt sizes (standard voltages)
Pearl—now cheaper than clear lamps.

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BRANCHES IN ALL THE PRINCIPAL TOWNS

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ZEISS

REFLECTOR LAMP

MODEL A.480

for the Lighting of RAILWAY STATIONS, YARDS, DOCKS, ENGINEERING SHOPS, SPORTS GROUNDS and all Open Spaces.

This model is fitted with a strong galvanized iron casing, black enamelled, which is watertight and weatherproof. The bell-shaped parabolic reflector of silvered glass is 19 in. diameter and is so arranged that all the light from the bulb is projected in a downward direction, thus ensuring the highest possible efficiency.

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There is a ZEISS Reflector Lamp for every purpose.

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In the power house

Add Spencer Conveyors to your equipment and Spencers will add to your profits.

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WILLCOX'S TRANSFORMER & OIL SWITCH INSULATING OIL

Absolutely FREE FROM MOISTURE and supplied in perfectly dry containers. Conforms to B.S. Specification, and has breakdown voltage of

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OILS

for STEAM TURBINES, DIESEL and OIL ENGINES, STEAM CYLINDERS, CRANK CHAMBERS, BEARINGS, DYNAMOS, GENERATORS, MOTORS & MACHINES

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"FISKE" (Pure Petroleum Base) GREASES

—the BETTER Greases for Cups, Gears, etc.

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85%
HYDRATED CARBONATE OF
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"NATSIL" SLABS.

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CELORON — A BAKELITE MATERIAL.

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ONE of the sights of London is the dome of the Coliseum outlined with Claude Neon tubes.

Seven years of continuous service has been given by this Claude Neon Installation.

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NEON LIGHTS (1928) LTD.
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Cheap heat!

IN THE FACTORY OR WORKSHOP!

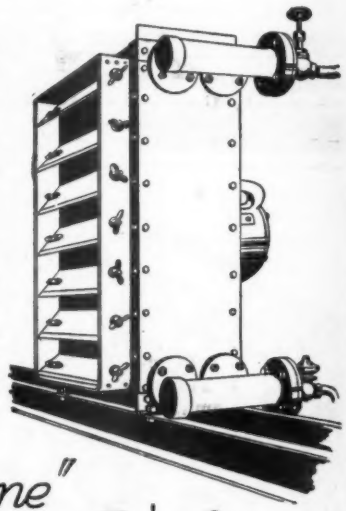
THE Cyclone Heater Unit introduces a new principle of heating—an extremely effective and economical system easy to instal.

Bolted to a wall or column at any suitable height, the Unit throws warm air down towards the floor at any preferred angle, thus distributing its heat with some degree of ventilation.

For extensions to workshops and for temporary premises, the Unit is particularly efficacious.

The advantages over the ordinary radiator are obvious.

Write for Folder 461U.



The "Cyclone" Heater Unit

MATTHEWS & YATES, Ltd., Swinton, MANCHESTER.

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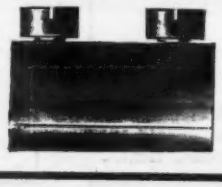
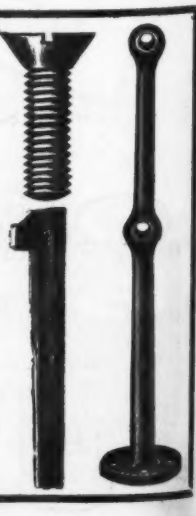
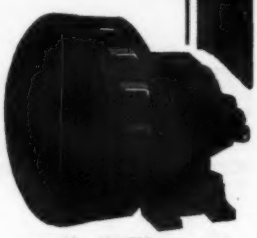




Electro Motor SYRENS



1/10 H.P SYREN.

Tangent Electro-Motor Syrens are necessary to every modern Industrial concern.

The 1/10 Horse-Power Model is specially designed to supply a long-felt want as an indoor Sound Signal, being easily heard in the noisiest workshop.

For Service Mains, A.C. or D.C., up to 250 volts.

We also manufacture other larger models for general and outdoor use, ranging from 3/16 to 8 horse-power.

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TANGENT Sound Signals include A.C. & D.C. Power Bells, Wood-Cased Bells, Buzzers, Etc.

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Established 1872

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Portable Electric Drills.

DRILLING metal or wood with Little Giant Portable Electric Drills is easy labour and increased production results from their use because they are fast, always fit, and have the all-essential staying power.

OUTSTANDING FEATURES

Ease of Manipulation.
Conveniently placed Trigger Switch.
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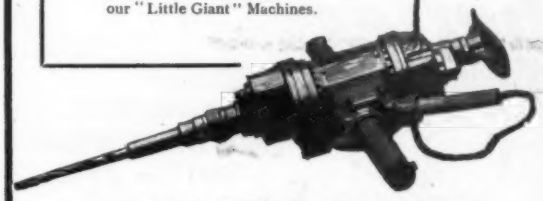
High Drilling Speed.
Ball Bearings throughout.
Air-Cooled Motor.

Write for Catalogue No. 15, giving full particulars of our "Little Giant" Machines.



Drill fitted to Cable Reel, which automatically takes up the slack of the cable.

The
Consolidated Pneumatic Tool Co.,
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Egyptian House, Piccadilly, London, W.1.
Main Works: Fraserburgh, Scotland.
Branches all over the world.

Two Connector Boxes in One!

No punishing of Conductors by sharp bends. A place for everything and everything in its place. A neat box with a large capacity.

Universal One-to-Four Way.

Each Way takes up to 3-Twin 3.029 Cables. Size only 3½ ins. Clamps removable, allowing Cable to be laid in flat.

NO LOOSE SCREWS. NO CUTTING TOOLS.

Easy and speedy to connect up.

Specially designed for India and the East, where a large number of Lights and Fan Circuits are taken from one service. WRITE FOR LIST M.W.

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J. C. WHITE & Co., Ltd.

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"ZAPON" ENAMEL

for all electrical fittings

Everyday use under most severe conditions is the regular lot of electrical equipment these days.

The life of an attractive finish depends on the lacquer with which it is protected and Crane's "Zapon" has been proved by large manufacturers throughout the country to give their work the best possible protection under present day conditions.

Send this coupon to obtain a sample for testing.

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Telephone: Victoria 0416, 0417 and 0418. Wires: "Chemical Birmingham."

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Electrical Review.

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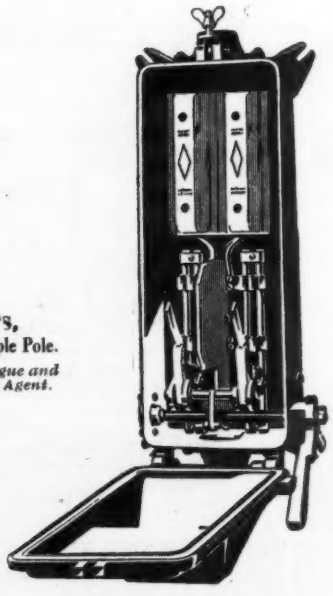
IS AS GOOD AS ANY —— and better than many

"VINCENT"
IRONCLAD COMBINED SWITCH FUSE

clearly leads its class in continuous efficiency under heavy-duty service.

Robust quality in the switch movement is supplemented by the unequalled VINCENT Patent Fuse Elements.

The substantial housing is lined with silicate enamel, and the mounting is in accordance with the latest practice.



600 VOLTS,
Double Pole & Triple Pole.
Write for Catalogue and Name of nearest Agent.

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Switchgear Manfg. Co., Ltd.,
SAMPSON ROAD NORTH
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SWITCH AND FUSEGEAR *ONLY*

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CONDENSING PLANT AUXILIARIES

STEAM AIR EJECTORS

2 or 3 Stage with Intercoolers in 1 Casing. We were the **first** firm to introduce Multi-Stage Air Ejectors into Great Britain, thereby revolutionizing Condensing Plant Development—**first then and first now.**

"HIVAC" EXTRACTION PUMPS

Single and 2 Stage, with Pressure Sealed Glands.

FEED WATER HEATERS

High and Low Pressure.

EVAPORATORS

COMPLETE CLOSED FEED SYSTEMS

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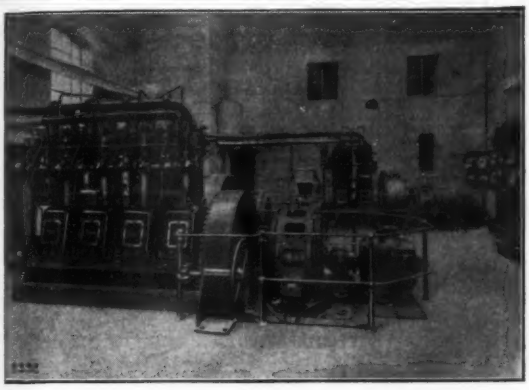
SELF-CLEANING CIRCULATING WATER-STRAINERS

HICK HARGREAVES & CO. LTD. BOLTON

Newry U.D.C. instal Paxman Oil Engines



Paxman Oil Engines direct coupled to G.E.C. Alternators installed at Newry U.D.C. Electricity Supply Station.

Other installations include—

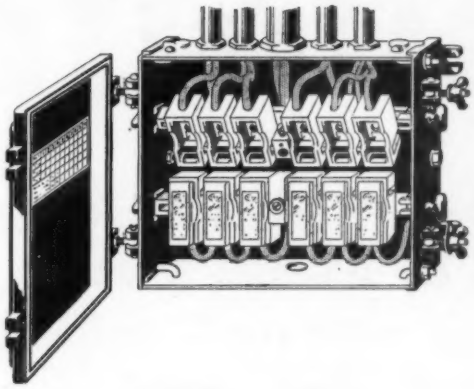
a 1,070 B.H.P. Engine for the Ashford U.D.C., and a further order for a 1,500 B.H.P. Engine.

The ELECTRICAL ENGINEER at ASHFORD in a recent letter states:—

"On looking over our generating costs for the year ending last March, I find that the cost of fuel per unit is '2705d. against '345d. of the previous year. This is satisfactory, and though a good deal of the saving is due to increased output, there is no doubt that some of it is due to the performance of your engine."

Electrical Engineers interested in the economical production of Power and Light should write for publication No. H952 to:

Davey, Paxman & Co., Ltd.
(Associated firm of Agricultural & General Engineers, Ltd.)
53-56, Aldwych House, Aldwych, London, W.C.2
Telephones: Holborn 4966-7 *Works: Colchester.*



Ready for IMMEDIATE USE.

This 10/15-amp. Ironclad Fuseboard can be handed direct to the wireman.

It is only necessary to knock out the steel discs when conduit or glands for special cables can be fixed immediately for any installation. There is no need to wait for drilling—erection costs and delay are saved.

Fitted with Home Office type fuses, and of M.E.M. standard of quality throughout.

M.E.M. Gear saves time and money and gives greater security at no greater cost.

SEND FOR LIST No. 175

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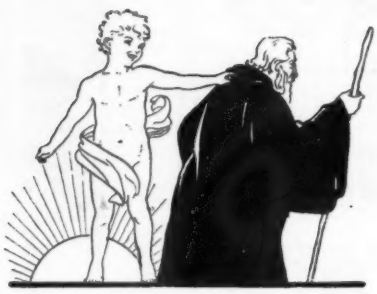
Ironclad Fuseboards.

MIDLAND ELECTRIC Manufacturing Co, Limited.
BARFORD ST. MEM BIRMINGHAM
SPECIALISTS IN IRONCLAD SWITCH & FUSE GEAR

Also at

LONDON, MANCHESTER, GLASGOW, NEWCASTLE, LEEDS, BRISTOL, BELFAST, DUBLIN, SYDNEY, BOMBAY, JOHANNESBURG, SHANGHAI, and BUENOS AIRES.

AND ALL ELECTRICAL WHOLESALERS.



BEST WISHES FOR 1930 . . .

THE ever-recurring promise of the New Year coincides this time with the certainty that 1930 will be a year of Prosperity for the whole Electrical Industry.

Big undertakings are nearing completion, others are in perspective. Both the one and the other are a virtual guarantee that the 1929 demand for electrical material will be greatly exceeded in 1930.

To our many Trade Friends we extend the compliments of the season, together with our congratulations on the excellent volume of business done in 1929.

In 1930—as in all years since 1898,—the SUNCO will be doing its part and to those who do not know what SUNCO SERVICE means we can think of no better wish than that they should have ample opportunity of experiencing its benefits in the opening year.

. . CONGRATULATIONS ON 1929

THE SUN ELECTRICAL Co. LTD

Telegrams—
"Secabilis, Westcent, London."
Telephone—
Temple Bar 3500
(10 lines).

118-120, Charing Cross Road,
LONDON———W.C.2.

LEEDS:
49-50, Park Place.
NEWCASTLE-on-TYNE:
112, Pilgrim Street.

ruminations

The road to Hell is paved with good intentions. You can ensure a smooth passage in whatever direction you are travelling by making a New Year resolution to use VENNER TIME SWITCHES. If you succeed in this they will pave your way to Heaven.

and a wish

TO FRIENDS IN THE TROPICS
A COOL BREEZE TO FAN YOU,
TO THOSE IN COOL CLIMATES
A HOT SUN TO TAN YOU,
IN TEMPERATE PLACES
FAIR WEATHER, NOT DIRTY,
TO FRIENDS EVERYWHERE

good luck 1930

VENNER TIME SWITCHES

Telephone: VICTORIA 2552 Private Exchange.

45, HORSEFERRY ROAD, WESTMINSTER, S.W.1.

Telegrams: "CLOXWICHES Phone, London."

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S. Africa.—Hubert Davies & Co., Ltd., Johannesburg, Durban, Capetown, Salisbury, Bulawayo, etc.

New Zealand.—Jas. J. Niven & Co., Ltd., Wellington, Auckland, Christchurch, Dunedin, etc.

Australia.—H. Rowe & Co., Melbourne and Sydney.

STAND 80, BARCELONA EXHIBITION.

Canada.—Lincoln Meter Co., Toronto.

Malay States.—Huttenbach, Lazarus & Sons, Ltd., Penang and Singapore.

Belgium.—M. Pierre Pollie, Rue de l'Abendance, Brussels.

Holland.—G.E.C. (Holland) Ltd., The Hague.

Portugal.—M.M. Mussche, Rua Garrett, Lisbon

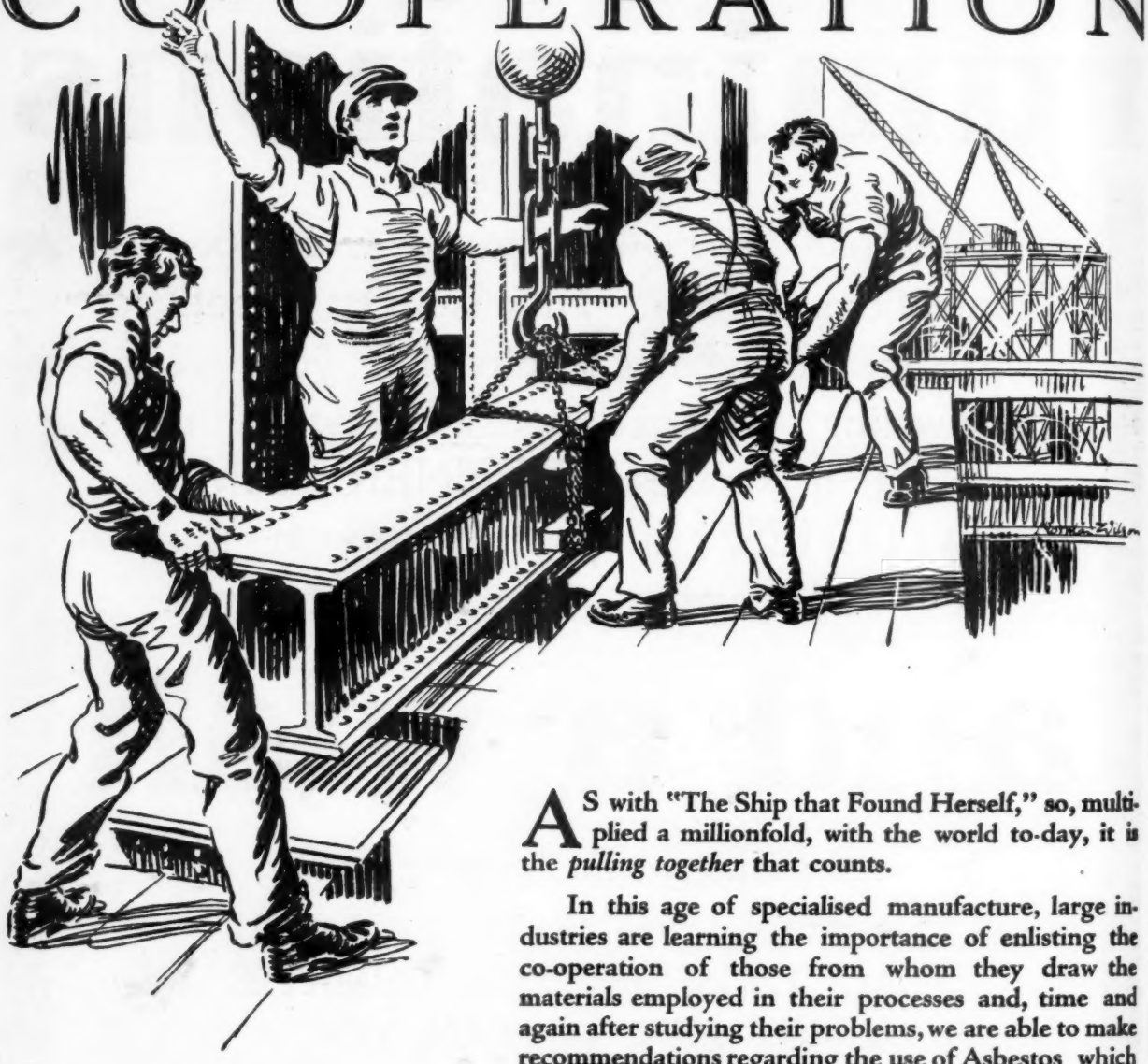
Spain.—Anglo Espanola de Electricidad, S.A., Barcelona, Madrid and Bilbao.

Norway.—Elektrisk Bureau, Oslo.

Denmark.—M. H. Larsen, Copenhagen.

Argentine.—Anglo-Argentine G.E.C., Ltd., Buenos Aires.

CO-OPERATION



AS with "The Ship that Found Herself," so, multiplied a millionfold, with the world to-day, it is the *pulling together* that counts.

In this age of specialised manufacture, large industries are learning the importance of enlisting the co-operation of those from whom they draw the materials employed in their processes and, time and again after studying their problems, we are able to make recommendations regarding the use of Asbestos which result in far-reaching economies. Is it not possible that our fifty years' experience would be of service to you?

Ebony "Sindanyo" was produced, after seven years' research, as a result of the closest co-operation with some of the largest electrical manufacturers in this country, and the whole Electrical Industry is, to-day, benefiting. Please send us your problems.

Switchboard with 'Sindanyo' Panels Reproduced by courtesy of The Metropolitan-Vickers Electrical Company Limited

C.F.H.3

"SindanyO"

REGISTERED

INSULATING BOARD.

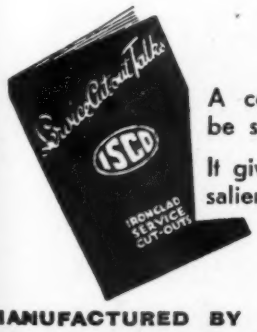
·DIELECTRIC·HOMOGENEOUS·STRONG·

TURNERS ASBESTOS CEMENT LTD.,
TRAFFORD PARK, MANCHESTER.

Please enquire for Brochure No. 13.

LOOK AT THE FUSE BASE

You can be sure it's an ISCO merely by looking at the fuse base. The simple method of fixing the terminal by means of the patent spring fork gives self-aligning contacts, and also does away with the screw passing through the base from the underside —always a possible source of failure should the compound stopping melt or fall out. There are many little features like that in ISCOS which make an Engineer say, "There's an ISCO!"



A copy of this Booklet will be sent Post Free on request

It gives full details of all the salient features of ISCO Cutouts

Big leads lead to big loads

STANDARDIZE THE 60 AMP. SERVICE

MANUFACTURED BY

W.T.HENLEY'S TELEGRAPH WORKS CO. LTD. HOLBORN VIADUCT. E.C.1

GLOVER'S "GLO-CLAD" WIRING SYSTEM

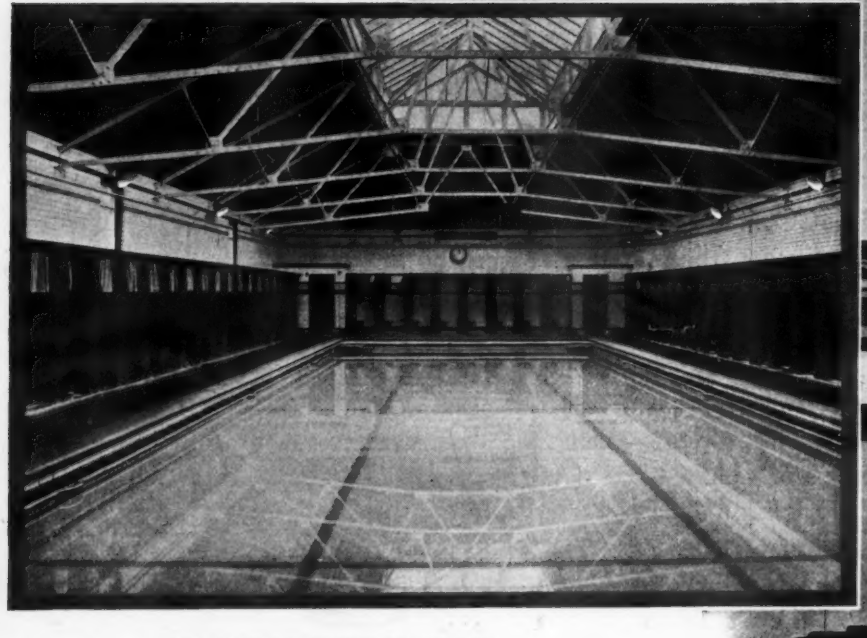
Ideal for Installations in SWIMMING BATHS, LAUNDRIES, BREWERIES, DISTILLERIES, ABATTOIRS, COLD-AIR STORAGES, CHEMICAL WORKS, PAPER MILLS, and all hazardous situations.

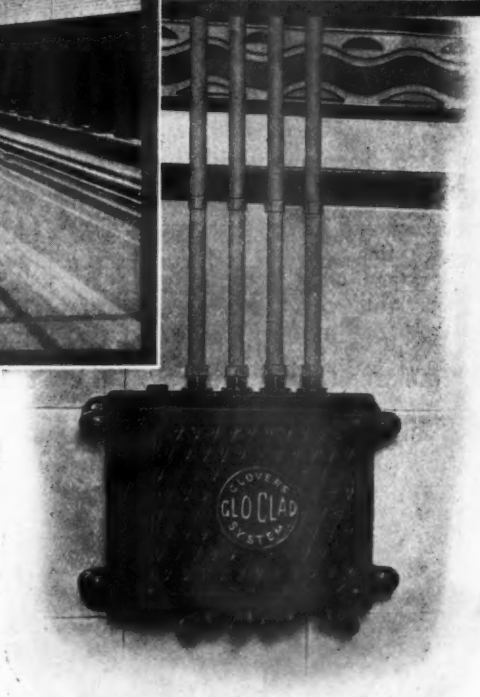
OBVIATES CONDENSATION TROUBLES.

ENSURES PERFECT BONDING.

EASILY INSTALLED.

NEAT APPEARANCE.





CHORLTON-CUM-HARDY BATHS.

A RECENT "GLO-CLAD" INSTALLATION

carried out for

THE MANCHESTER CORPORATION

by

Messrs. MAITLAND & CO. (MANCHESTER), LTD.,

Electrical Engineers,

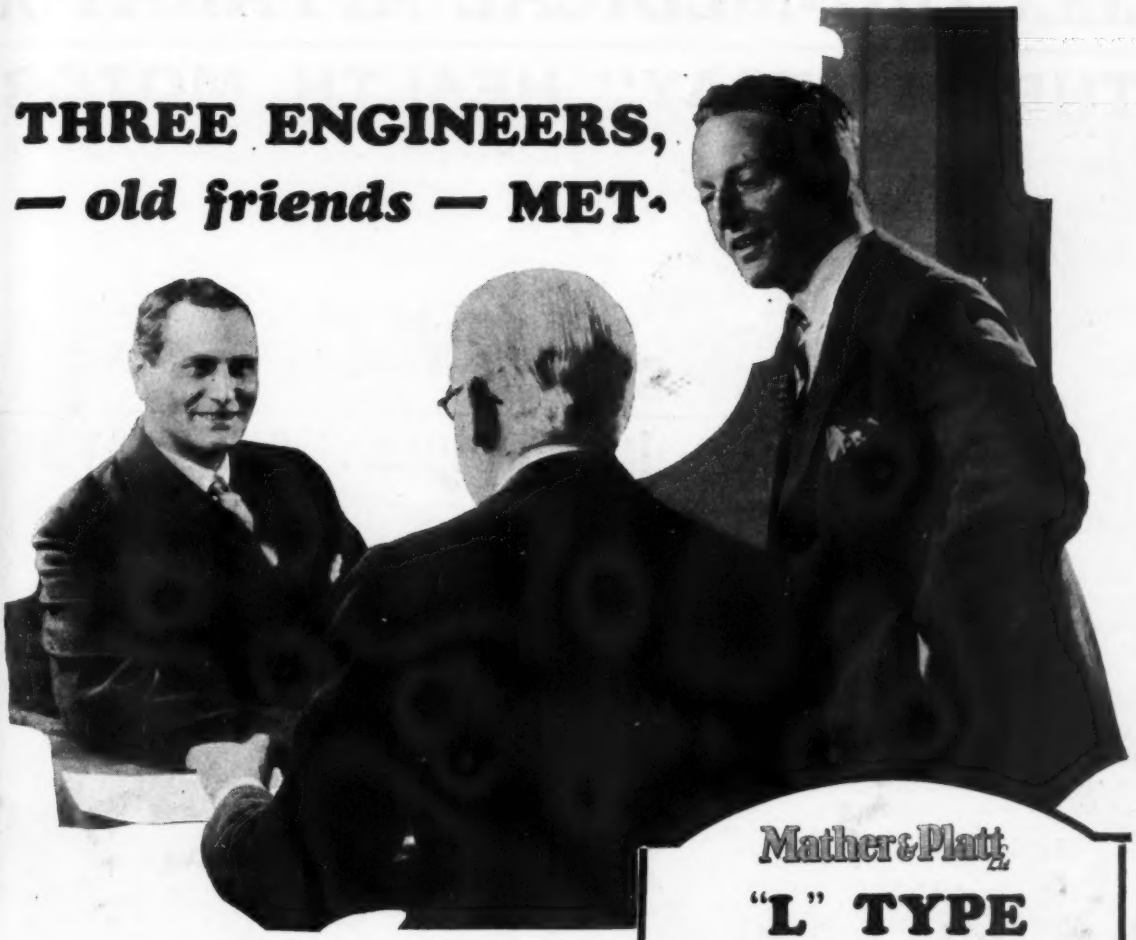
29, PRINCESS STREET MANCHESTER.

WRITE FOR CATALOGUE No. 22.

W. T. GLOVER & Co., Ltd.,

TRAFFORD PARK - - - MANCHESTER.

THREE ENGINEERS, — *old friends* — MET.



—and of course conversation turned towards "shop" and electric motors in particular. They knew the good points of a motor and were unanimous in placing Mather & Platt Machines in the forefront.

The first, a colliery man, had never found a motor to stand up so well to the arduous conditions of his work.

The chemical works manager found his production steadier by virtue of fewer breakdowns—a tribute to the sound workmanship in a Mather Motor.

And the other, a consultant, was impressed by the theoretical points of design and winding and by the solid construction of all the vital parts.

If you would care for information about Mather and Platt Electric Motors—either A.C. or D.C. write for booklet E 77a—or leaflets on any special type in which you are interested.

Mather & Platt Ltd

Electrical & Hydraulic Engineers

PARK WORKS, MANCHESTER

and at

Park House, 22, Great Smith Street, London, S.W.1

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"L" TYPE

Induction Motors

FOR EVERY ELECTRIC DRIVE

Mather & Platt "L" Type Motors are simple, "clean," and robust in design, adaptable to widely varying conditions yet low priced. New resources, improvements in materials and a reorganisation of production methods have made this Motor possible—a better motor at a more advantageous price.

Reliability and electrical efficiency are higher than ever before. All L type motors comply in every respect with British Standard Specification No. 168/1926.

Every "M. & P." motor is tested for 4 to 6 hours under Load—it is the users' safeguard.

Write for Catalogue E. 77a.

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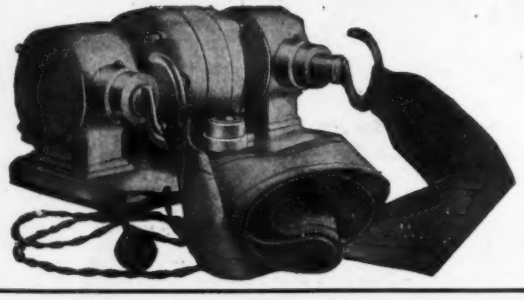
A MOTOR FOR EVERY ELECTRIC DRIVE

ELECTRO-MEDICAL APPARATUS

THE "EMESAY" HEALTH MOTOR



The latest apparatus for manipulative and general massage. Especially recommended for its tonic action and for the cure of obesity, etc.

This apparatus is now in general demand by dealers in electrical equipment.

It is entirely British Made in our own London Works.

PRICE £28 for D.C. or A.C.

THE "MEDISUN" ULTRA-VIOLET APPARATUS

Running Cost: 30 Treatments for 3d.

The "MEDISUN" Ultra-Violet Light Apparatus is of the quartz mercury vapour type. It has been so designed as to eliminate all unnecessary expense, and yet provide an efficient source of ultra-violet radiation, quick in its reaction speed, not requiring adjustment, and foolproof in its mechanical details. Whilst the price of the "Medisun" is quite low, its appearance is really first-class. Manufactured in polished aluminium throughout, it does not require frequent cleaning, is designed to stand on any table, weighs only 14 lbs., and is a thoroughly reliable piece of apparatus.

PRICE, for use on direct current - **£12**

PRICE, for use on alternating current **£18**

STANDARD MODEL

on Telescopic Floor Stand from which the Lamp may be readily detached.

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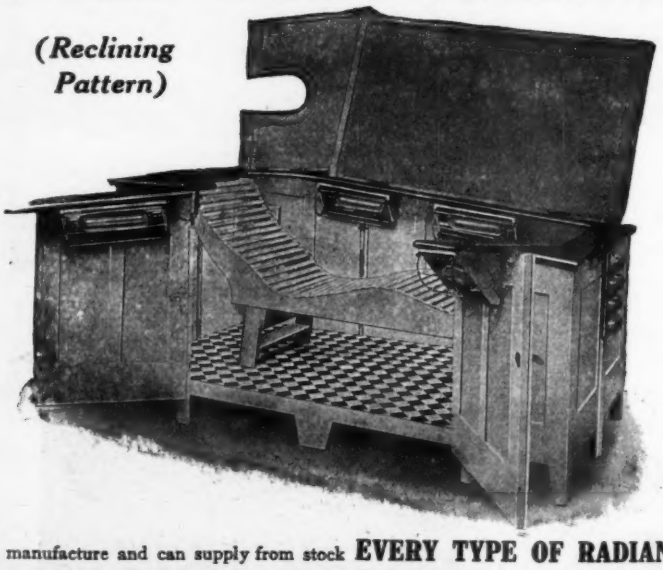
FULL BODY RADIANT-HEAT BATH

(Reclining Pattern)



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Temperature is easily regulated by the controlling switches fitted at one end of the bath.

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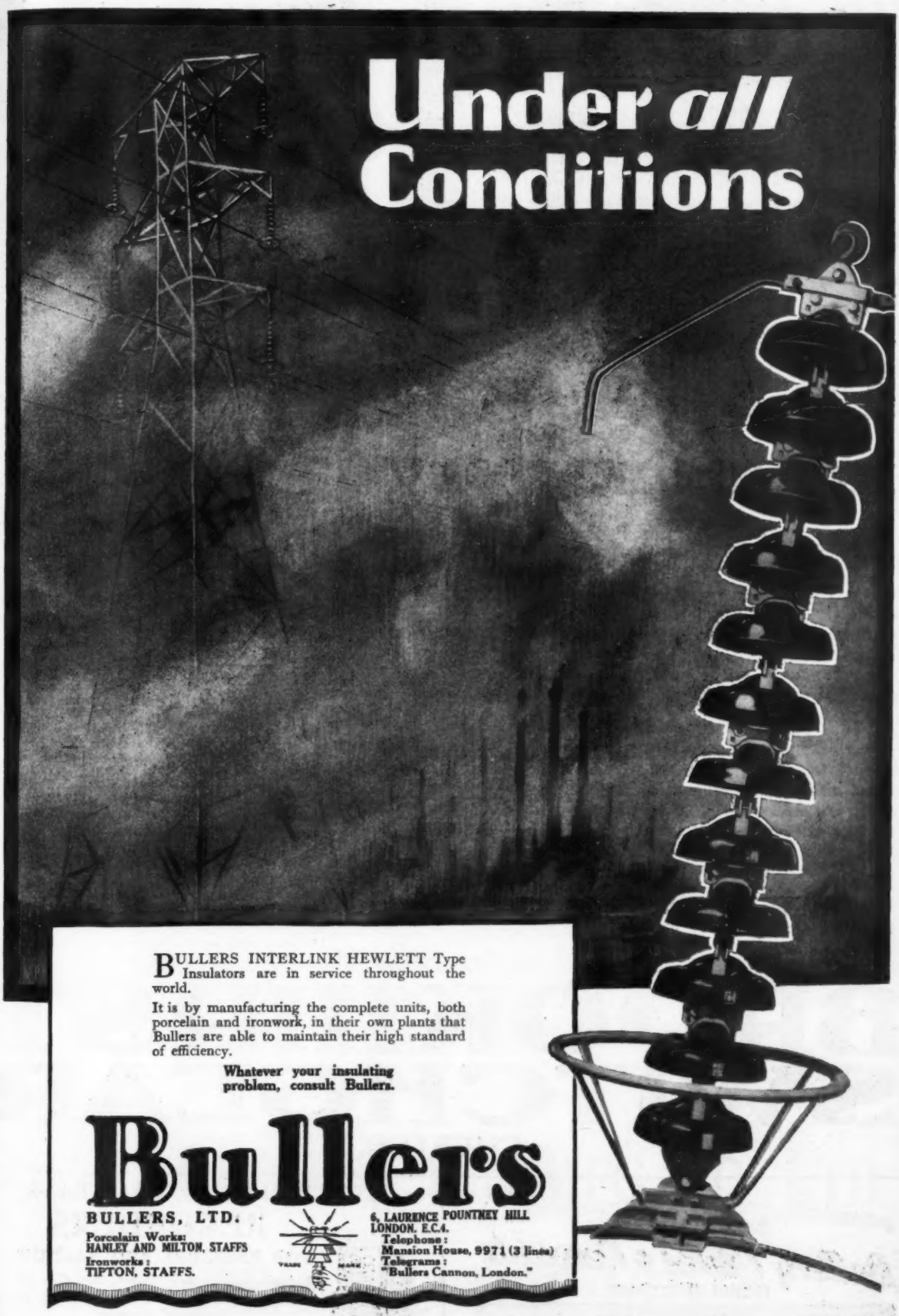

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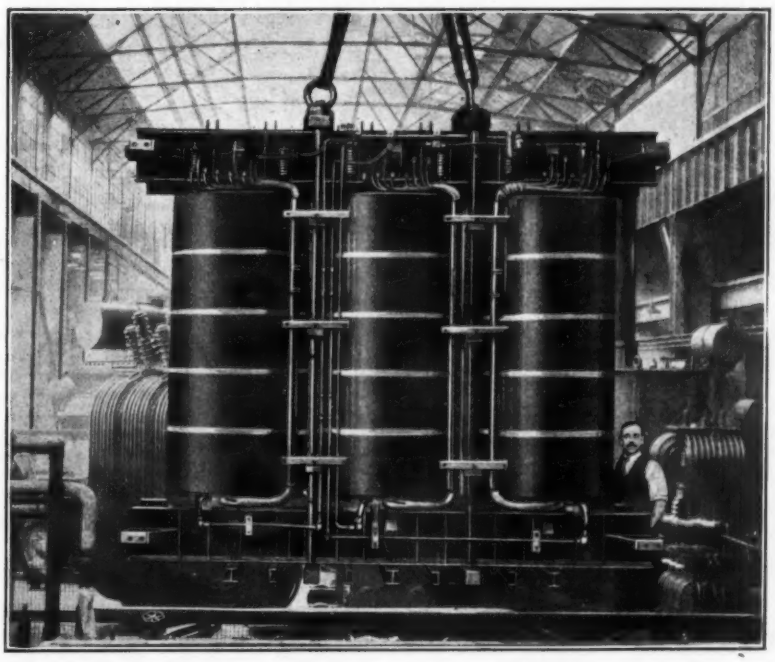

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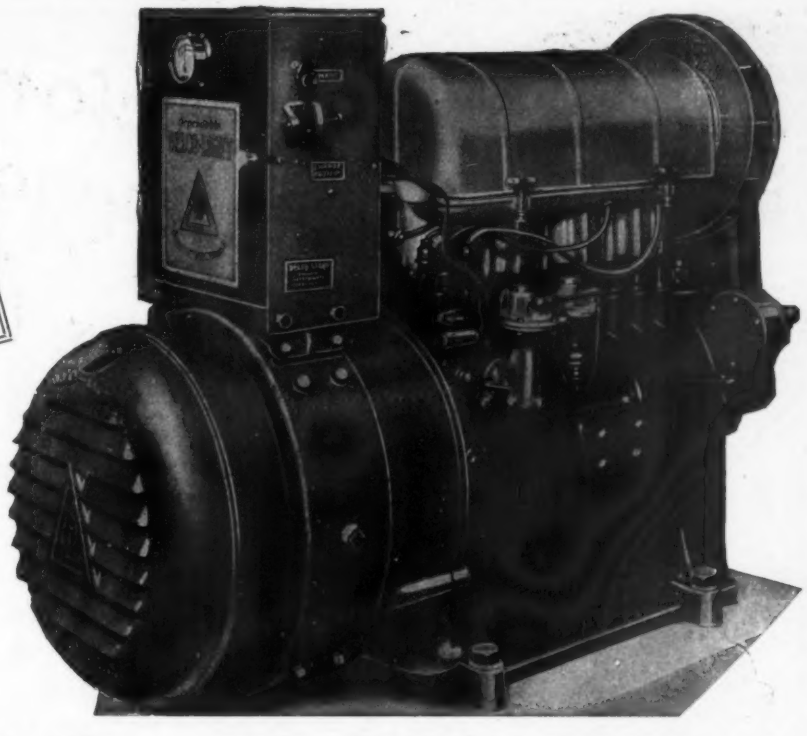

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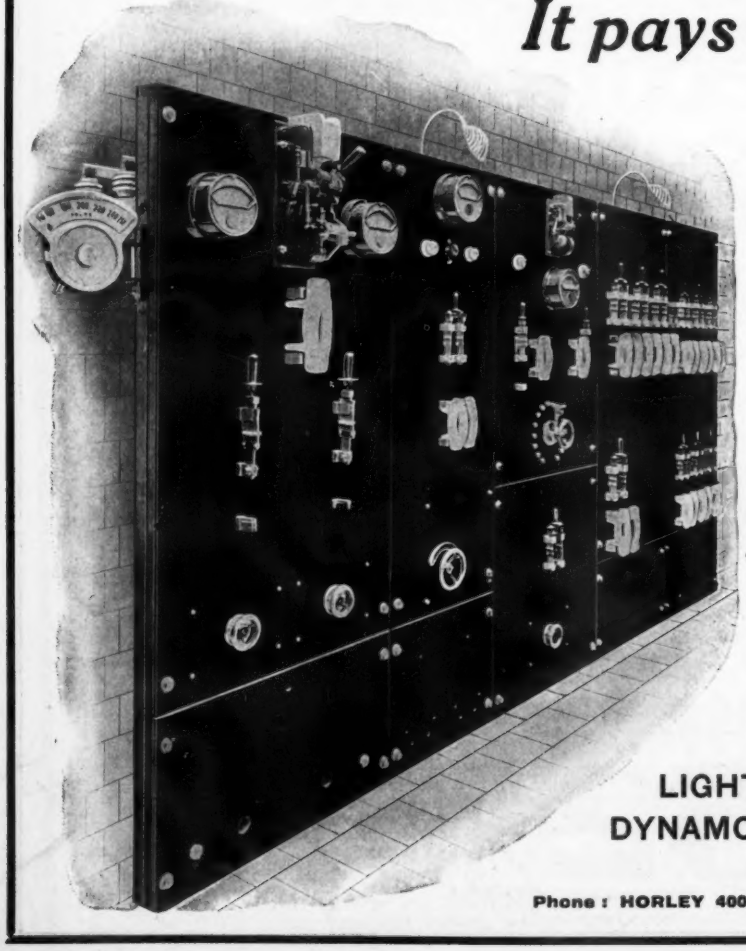

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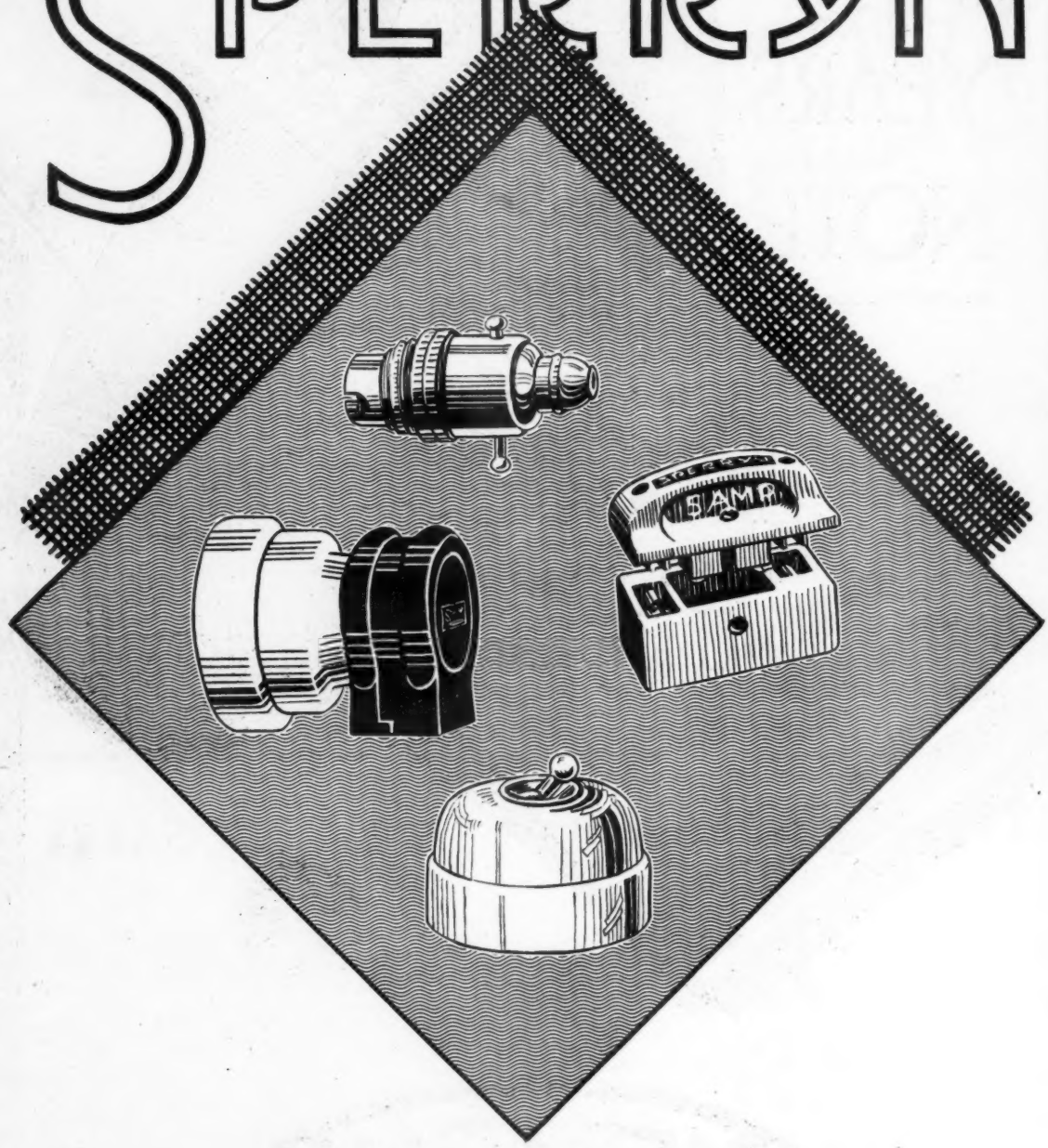

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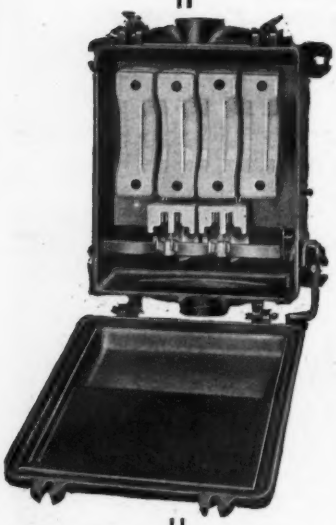

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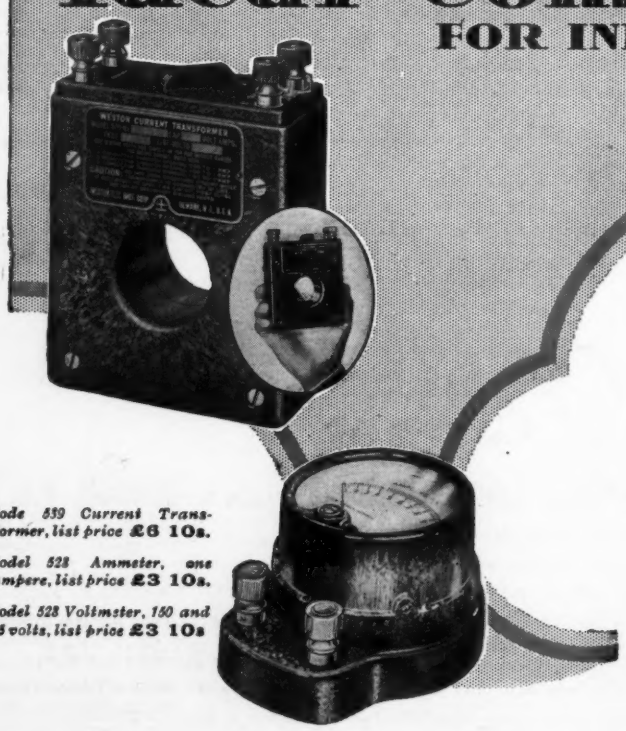

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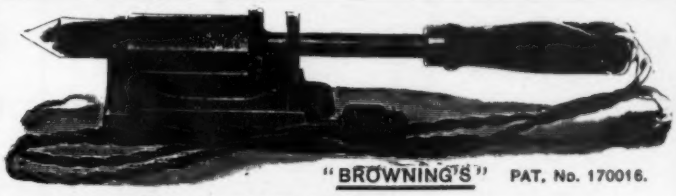

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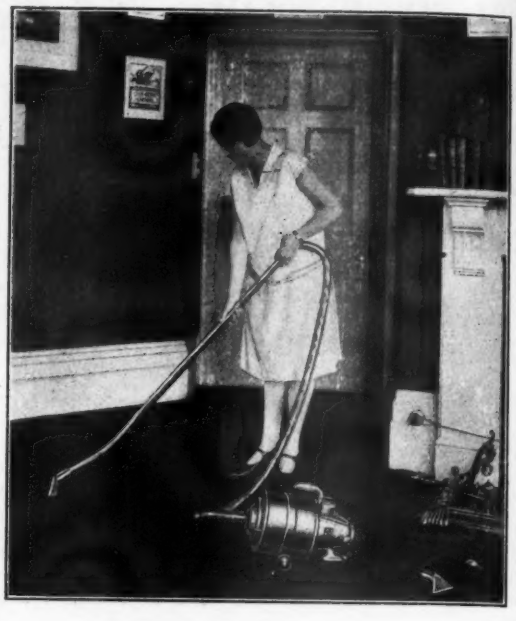

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BY MEANS OF

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METAL RECTIFIERS

and dispense with valves, chemicals, moving parts, and constant renewals. They require no maintenance or attention, and their high efficiency is maintained over practically their whole range of output.

Send for Pamphlet D.P. 11r describing our complete range of sets.

Above is shown a group of Westinghouse Metal Rectifiers used for battery charging at the Electricity Department of the County Borough of West Ham.

Photo by courtesy of the Engineer and Manager.

The Westinghouse Brake & Saxby Signal Co., Ltd.,
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Their big and special features are :—

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All our 2 and 3-pin types will carry 100° overload.

Support the E.D.A. Outlets Campaign

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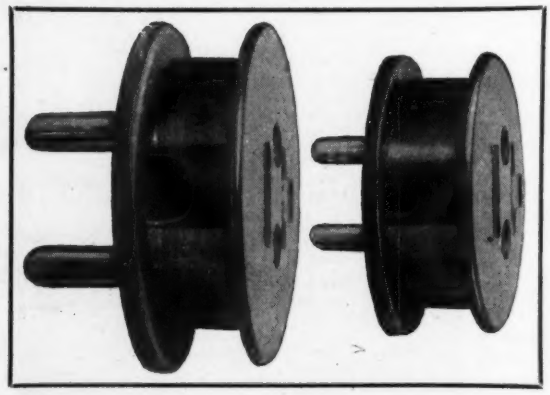

A 15-amp. Santon Reducing Plug, costing **1/8,** fitted to the Radiator, or used as a standby, will take a series of 5-amp. Santon Multi Plugs, costing **1/3** (fused **1/6**), on the same heating point.

SEND FOR PLUG LIST

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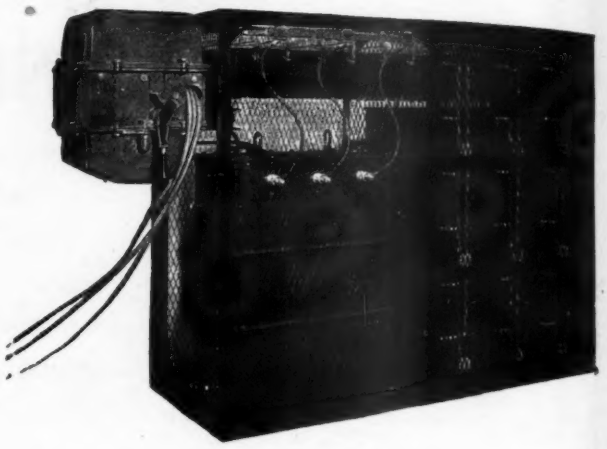

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Both in design and construction they are mechanically perfect and give the highest electrical efficiency.

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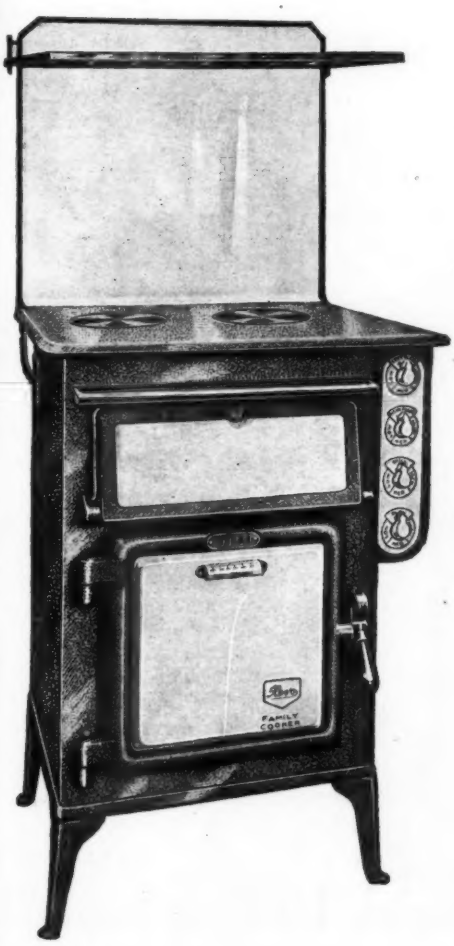

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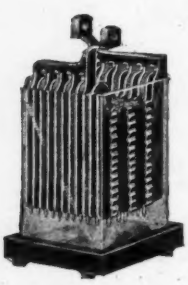

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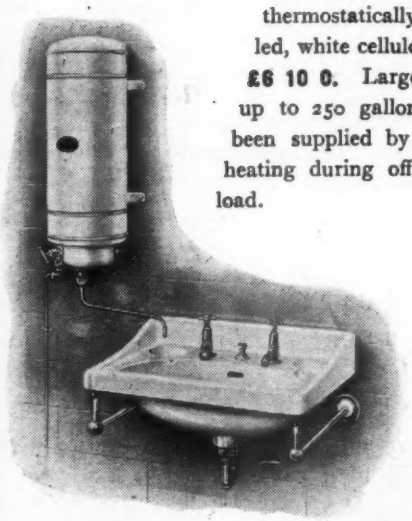

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Tubular or bladed type for water heating. Elements in tubular type may be withdrawn without unscrewing heater from tank. Manufactured in various sizes and types for all requirements.

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Immersion Heaters specially designed for Oil heating—*ask for list O.H.29.*

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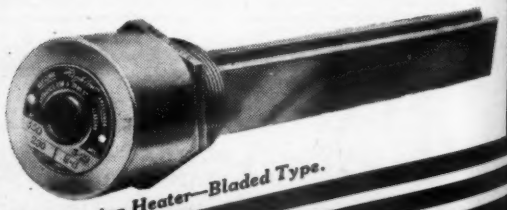

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This compact Fire is specially designed for this purpose.

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Carron Company's Booklet No. 24 R illustrates a pleasing variety of attractive fires and gives much information.

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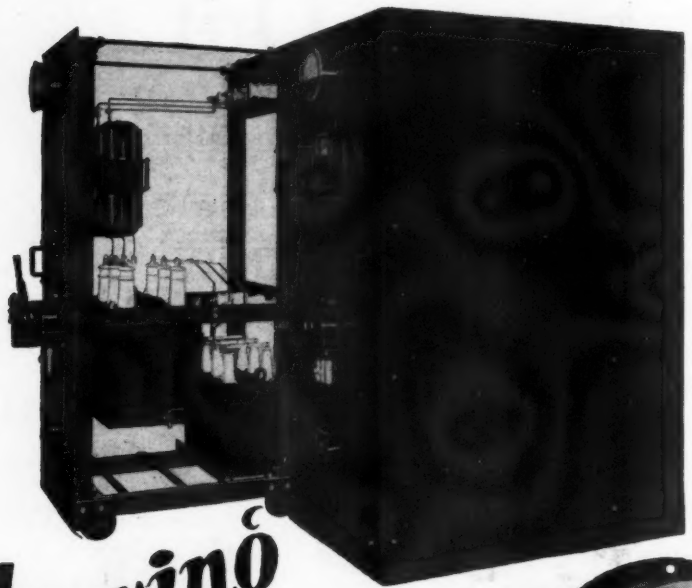

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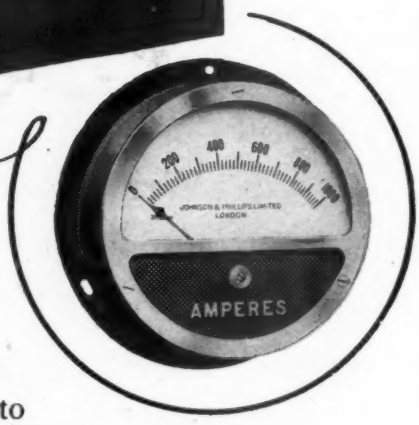

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Branches throughout the Provinces and the Empire.

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J. & P. CABLES

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The prestige of J. & P. Cables stands high amongst Architects, Consultants, and others responsible for high-class installation work. Accompany your tender with our Guarantee Form (supplies on application) certifying that you have included for J. & P. Cables.

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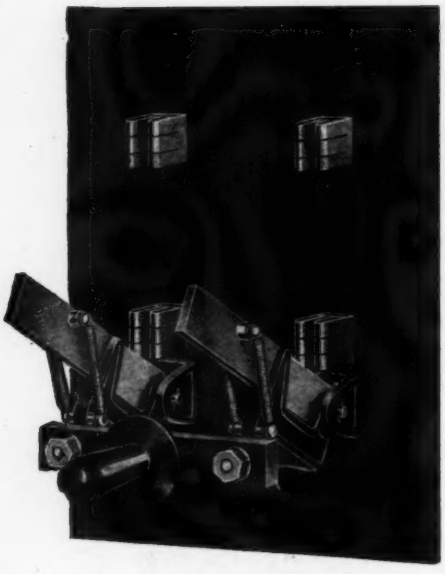
THE "WECOL" KNIFE SWITCH

(Dead Hinge Type)



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Simplest in Construction—
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In every detail of design and construction the "Wecol" Knife Switch is built to the highest standard of Electrical and Mechanical Efficiency.

It possesses the added advantage of occupying less space than many others of the same Electrical Capacity.

Blades and Contact Tips—
are of best High Conductivity Copper. Capacity rating to I.E.E. Regulations and British Standard Specification.

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Best Malleable Castings all drilled to Jigs and interchangeable.

Supplied for Capacities from 15 to 500 amps.

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Send to-day for the 'Book of Apex' giving the full range of 'APEX' Switches and Distribution Boards illustrated and described, together with particulars of price reductions.

If you would like to see a representative, you may rest assured of intelligent co-operation in your requirements

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BRANCHES: Birmingham, Bristol, Glasgow, Leeds, Liverpool, Manchester, Newcastle, Sheffield, S. Wales.
Established 1903.

The Cheapest Fused Switch on the Market.

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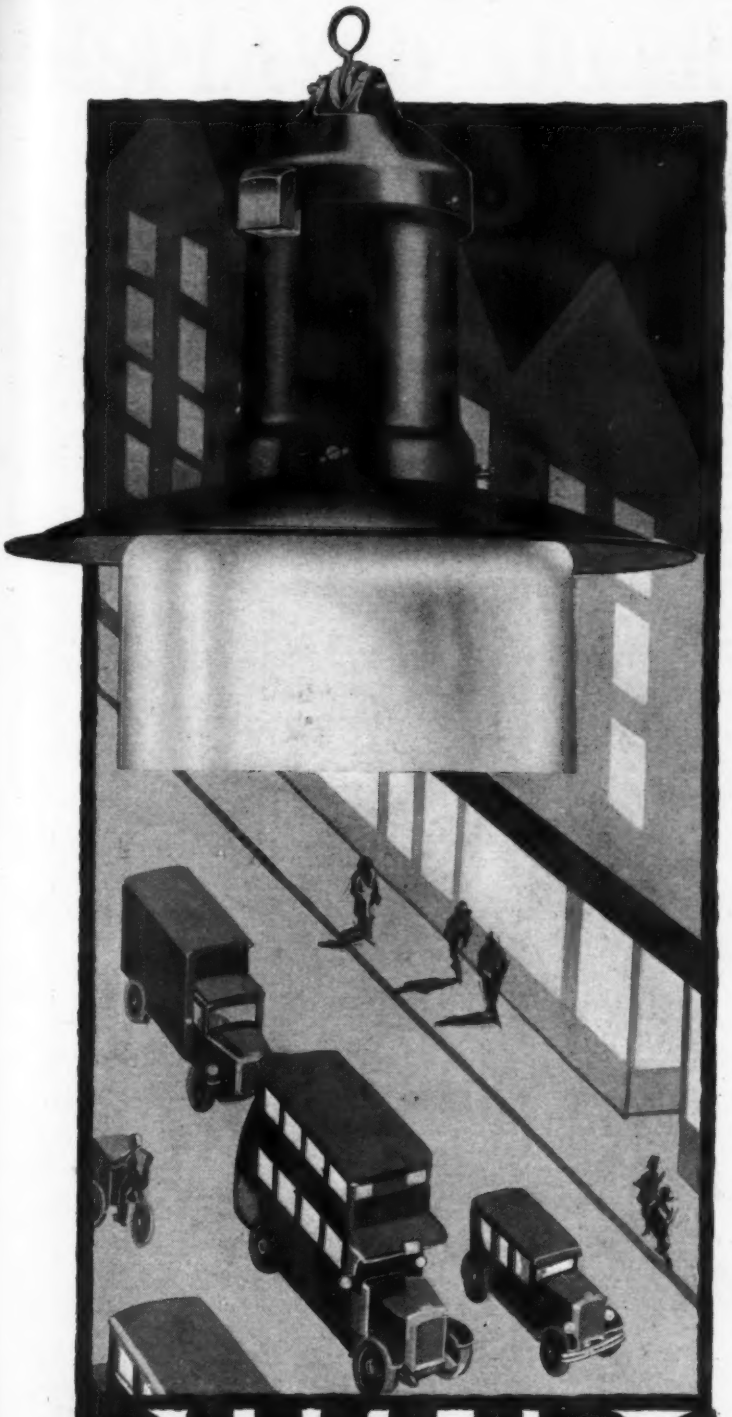
List price **3s. 10d.** each for gross lots.
Prices quoted for smaller quantities on application.



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Modern street lighting conditions demand fittings of quality. Those in the Philips range combine efficiency with good appearance.

Type N.A.35 illustrated above represents the latest achievement in street lighting fittings. The cylindrical globe of three ply opal glass concentrates most of the light on the road and also illuminates adjacent buildings with diffused light giving a very pleasant appearance to main thoroughfares.

A patent device ensures the lamp being in the correct focal position.

The fitting is sent out completely wired and it is only necessary to connect the lead-in wires to the terminal blocks incorporated in the cast iron canopy. The wires from these terminal blocks to the holder are insulated with fish beads, no rubber (which is liable to perish) being used.

THERE IS A PHILIPS FITTING FOR EVERY COMMERCIAL PURPOSE.

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Made by the Manufacturers of the famous Argenta Lamps and All-Electric Radio Receivers and Neon Signs.

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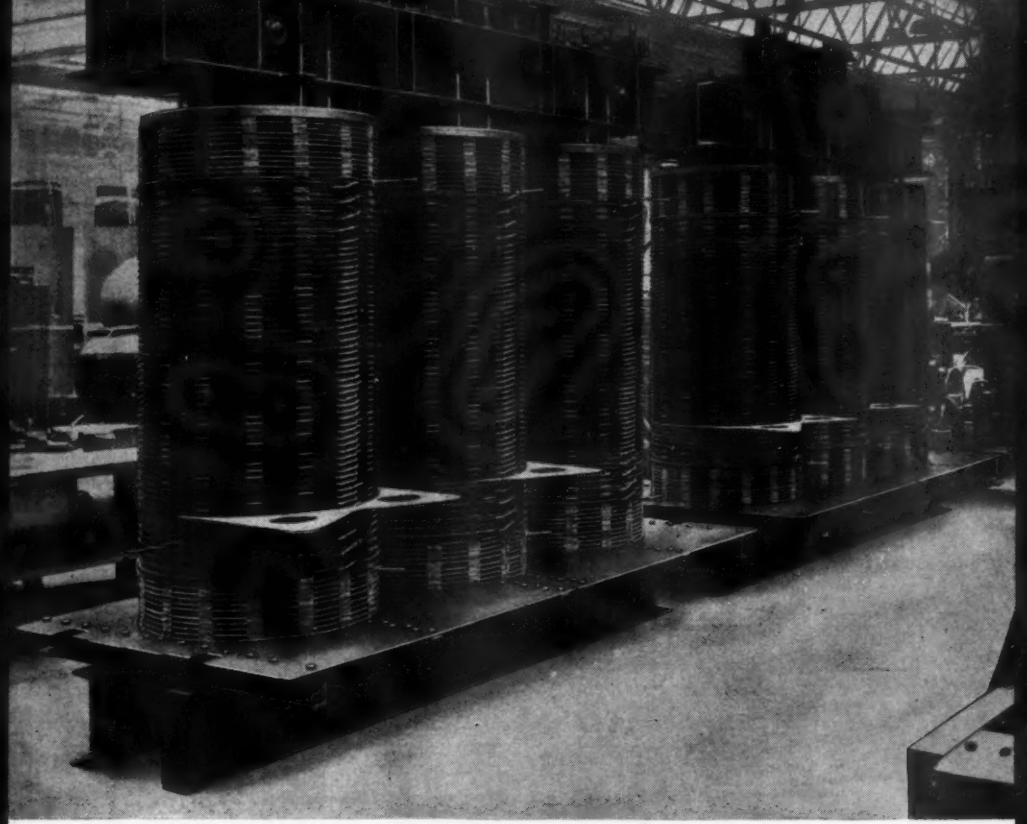

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OF THE WEEK PREVIOUS TO ISSUE.

OFFICIAL NOTICES, PATENT NOTICES, SITUATIONS VACANT, SITUATIONS WANTED, PARTNERSHIPS, AGENCIES, ARTICLES FOR SALE, ARTICLES WANTED, ETC.

Latest Time 5 p.m. TUESDAY.

The ELECTRICAL REVIEW is the recognised Medium of the Electrical Trades, and has BY FAR THE LARGEST CIRCULATION of any Electrical Industrial Paper in Great Britain.

THE "ELECTRICAL REVIEW'S" SUGGESTIONS
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ELECTRICAL POWER ENGINEERS' ASSOCIATION

Scarborough Corporation.

NOTICE is given of the existence of a difference between the above Corporation and the Association relative to the dismissal of a member, which difference has been referred to the National Joint Board.

CONSEQUENT UPON this Dispute, and pending a settlement, MEMBERS OF THE ASSOCIATION ARE ENJOINED TO REFRAIN FROM APPLYING FOR OR ACCEPTING ANY APPOINTMENT WITH THE ABOVE CORPORATION.

W. ARTHUR JONES, A.M.I.E.E.,
General Secretary.

102, St. George's Square,
London, S.W.1. 3333

SITUATIONS VACANT.

Latest time for receiving 5 p.m. Tuesday.

If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of Advertisers using a number in any way be disclosed.

Original Testimonials should never be sent.

CITY OF CHESTER.

Engineer for Development of Showroom and Use of Electricity.

APPLICATIONS are invited from Electrical Engineers who have had a technical education and training and practical experience in the application of electricity for domestic, business and industrial purposes, management of showrooms, and generally in promoting the extensive use of electricity by consumers.

Salary £300 per annum, rising, subject to satisfactory service by increments of £25 to a maximum of £400 per annum.

The successful candidate will be required to undergo a medical examination and contribute to the Council's Superannuation Scheme.

Applications, stating age, details of education, technical training and experience, with copies of recent testimonials, to the undersigned on or before December 30th, 1929.

J. H. DICKSON,
Town Clerk.

Town Hall, Chester.
December 14th, 1929. 3777

CITY OF SALFORD.

Electricity Department.

APPLICATIONS are invited for the position of Junior Assistant Mains Engineer, salary in accordance with N.J.B. Schedule, Grade 10.B, Class H, present value £211 13s.7d., subject to deductions for Superannuation Scheme after twelve months' satisfactory service.

Thorough technical training is essential, and experience in surveying and estimating for mains extensions and services desirable.

Applications, stating age, training and experience, to the City Electrical Engineer, Frederick Road, Salford, not later than January 10th, 1930.

3798 H. H. TOMSON, Town Clerk.

SITUATIONS VACANT.—*Continued.*

COUNTY BOROUGH OF WEST HARTLEPOOL.

Appointment of Borough Electrical Engineer.

APPLICATIONS are invited from qualified Electrical Engineers, who must have sound commercial ability and experience, for the position of Borough Electrical Engineer, upon forms to be obtained from me which must be delivered duly completed and endorsed "Borough Electrical Engineer" at the Municipal Buildings, West Hartlepool, not later than Saturday, the 11th January 1930.

The salary, which will be in accordance with the National Minimum Scale of Salaries for Chief Electrical Engineers of authorised Electricity Supply Undertakings, amounts to £1,125 for the current year.

The person appointed will in all probability be appointed to the position of Transport Manager which would carry with it an additional salary of £150 per annum.

Canvassing directly or indirectly will be a disqualification.

HAROLD W. STANTON,
Town Clerk.

Municipal Buildings,
West Hartlepool,
December 20th, 1929. 3812

CITY OF MANCHESTER.

Electricity Department.

POWER STATIONS ENGINEER.

THE Electricity Committee of the Manchester Corporation invite applications for the position of Power Stations Engineer.

Experience in large power station operation is essential, and candidates must be Corporate Members of either the Institution of Electrical or Mechanical Engineers.

Commencing salary: £900 per annum, rising to £1,000, by annual increments of £50.

Applications, giving full particulars of technical training, experience and age, together with copies of recent testimonials, must be endorsed "Power Stations Engineer," and reach the undersigned not later than 10 o'clock a.m. on Saturday, January 4th, 1930.

F. E. WARBRECK HOWELL,
Town Clerk.

Town Hall, Manchester.
December 17th, 1929. 3799

CITY OF NORWICH.

Electricity Department.

MAINS ASSISTANT.

APPLICATIONS are invited for the position of Assistant in the Mains Department.

Applicants must have had technical training and experience in the erection of overhead high and low tension mains.

Salary in accordance with N.J.B. Schedule, Class G, Grade 9a (present value £251 3s. 2d. net).

Applications, stating age, and giving full particulars, together with copies of testimonials, to be sent to the undersigned.

F. M. LONG,
City Electrical Engineer.

Corporation Electricity Works, Duke Street, Norwich.
December 17th, 1929. 3796

BATTERSEA BOROUGH COUNCIL.

Electricity Department.

WANTED.—Cable Jointers with experience in working on live low tension mains.—Apply in writing, giving full particulars of experience and when able to commence duties, to the Borough Electrical Engineer, Electricity Works, Lombard Road, Battersea, S.W.11. 3805

Cheap prepaid Advertisements are inserted under this heading at the rate of One Penny Per Word (minimum 1s.). Three consecutive Insertions for the price of two, if ordered and prepaid with first insertion.
Box Number and ELECTRICAL REVIEW address count as seven words.

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ASSISTANT Electrical Designer required, with experience of direct current design up to 300 kW; a.c. experience an advantage.—Apply, stating age, training and salary required, with copies of testimonials, to Sunderland Forge & Engineering Co., Ltd., Pallion, Sunderland. 3720

ASSISTANT required in design office. Applicants must have technical college training and workshop training and some practical experience in a design office.—Apply in writing, stating experience, training and salary required, to the Chief Designer, G.E.C. Engineering Works, Witton, Birmingham. 3731

SITUATIONS VACANT.—*Continued.*

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BAKELITE and moulded productions. Birmingham firm desire to appoint Representative; must have sound connection for small articles.—6417, Electrical Review, 4, Ludgate Hill, London.

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DRAUGHTSMAN required with experience on the layout of control gear for automatic sub-stations.—Apply, stating age, full experience and salary required, to Switchgear Department, General Electric Co., Ltd., Witton, Birmingham. 3811

DRAUGHTSMEN required, with experience on high and low tension switch cubicles, &c.—Apply, stating age, full experience, and salary required, to the Switchgear Department, General Electric Co., Ltd., Witton, Birmingham. 3773

DRAUGHTSMEN wanted; good knowledge of P.O., P.B.X., switchboards, automatic telephone switchboards and general experience of electrical apparatus. Only those with initiative and energy need apply.—Write full details of practical and theoretical training, &c., and salary required, to 3699, Electrical Review, 4, Ludgate Hill, London.

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REPRESENTATIVES required for London and also S.E. England for sales of electric tools. Salary and expenses. Good connection essential.—6453, Electrical Review, 4, Ludgate Hill, London.

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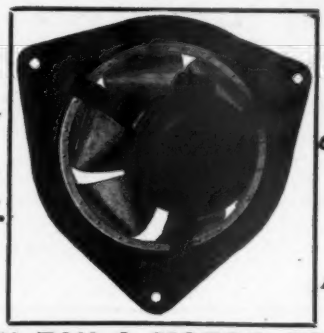

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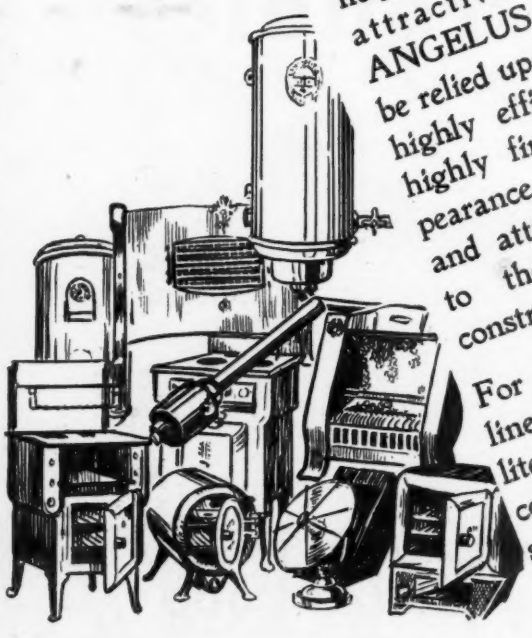

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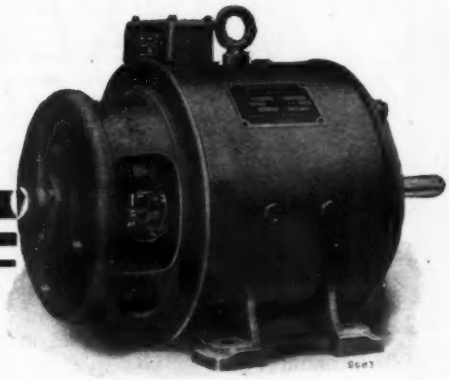

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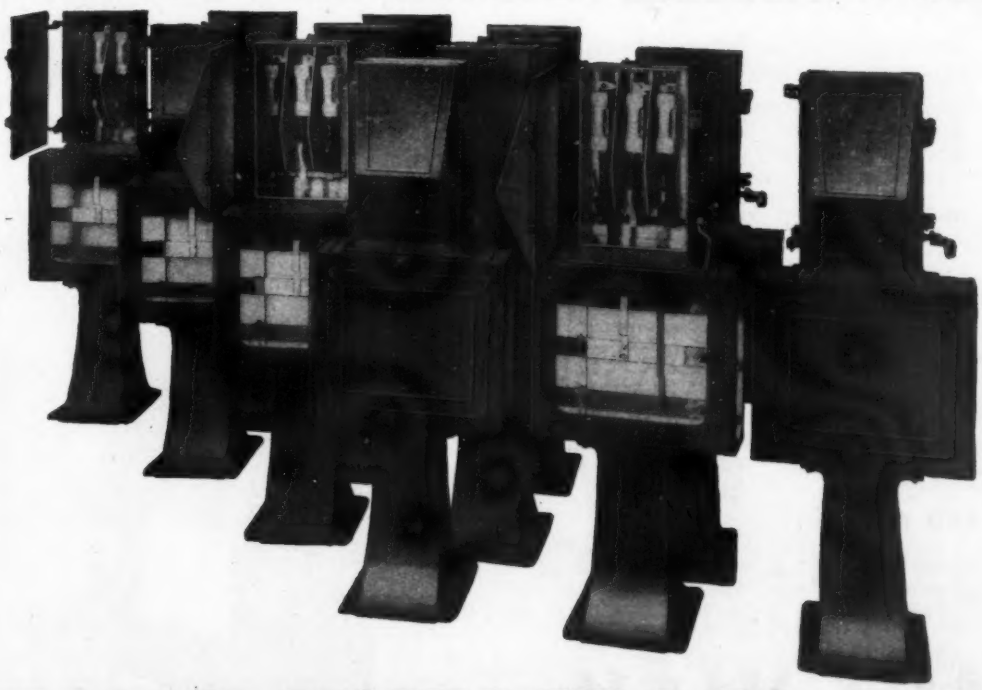

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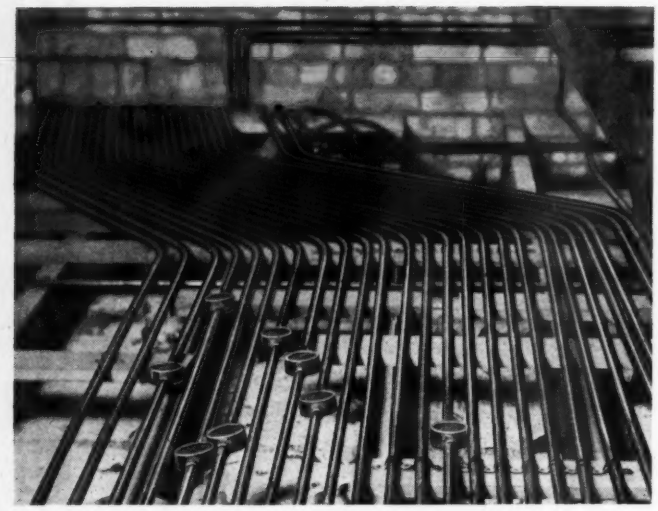

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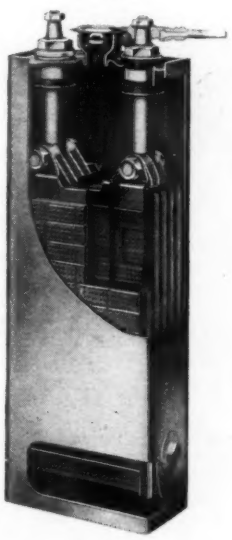

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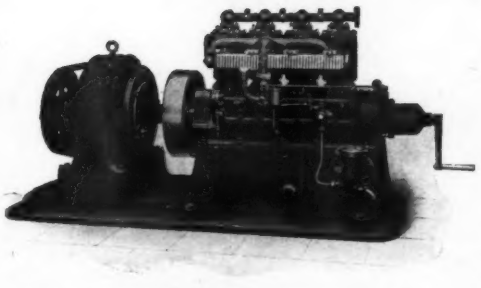

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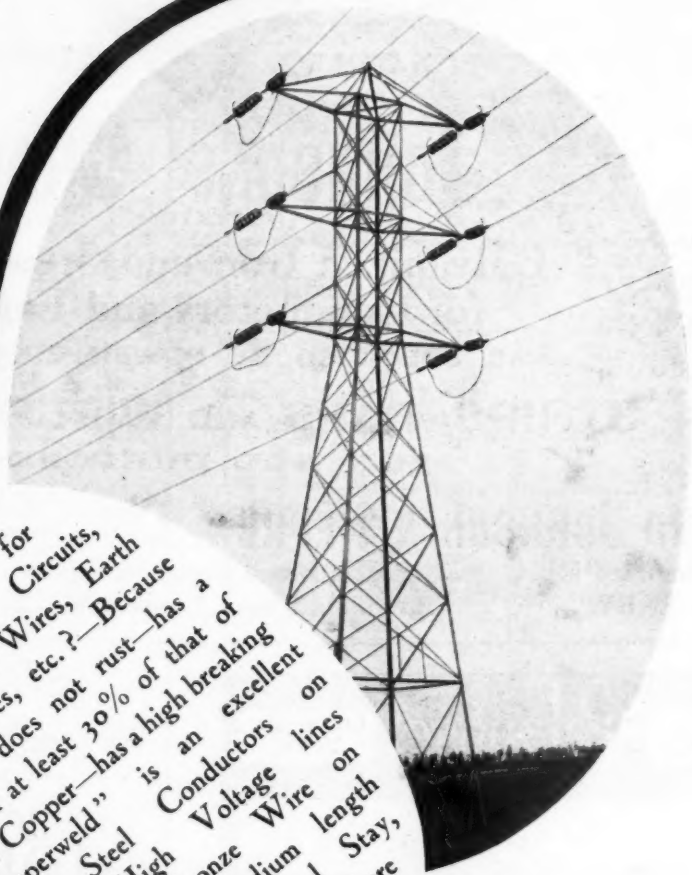

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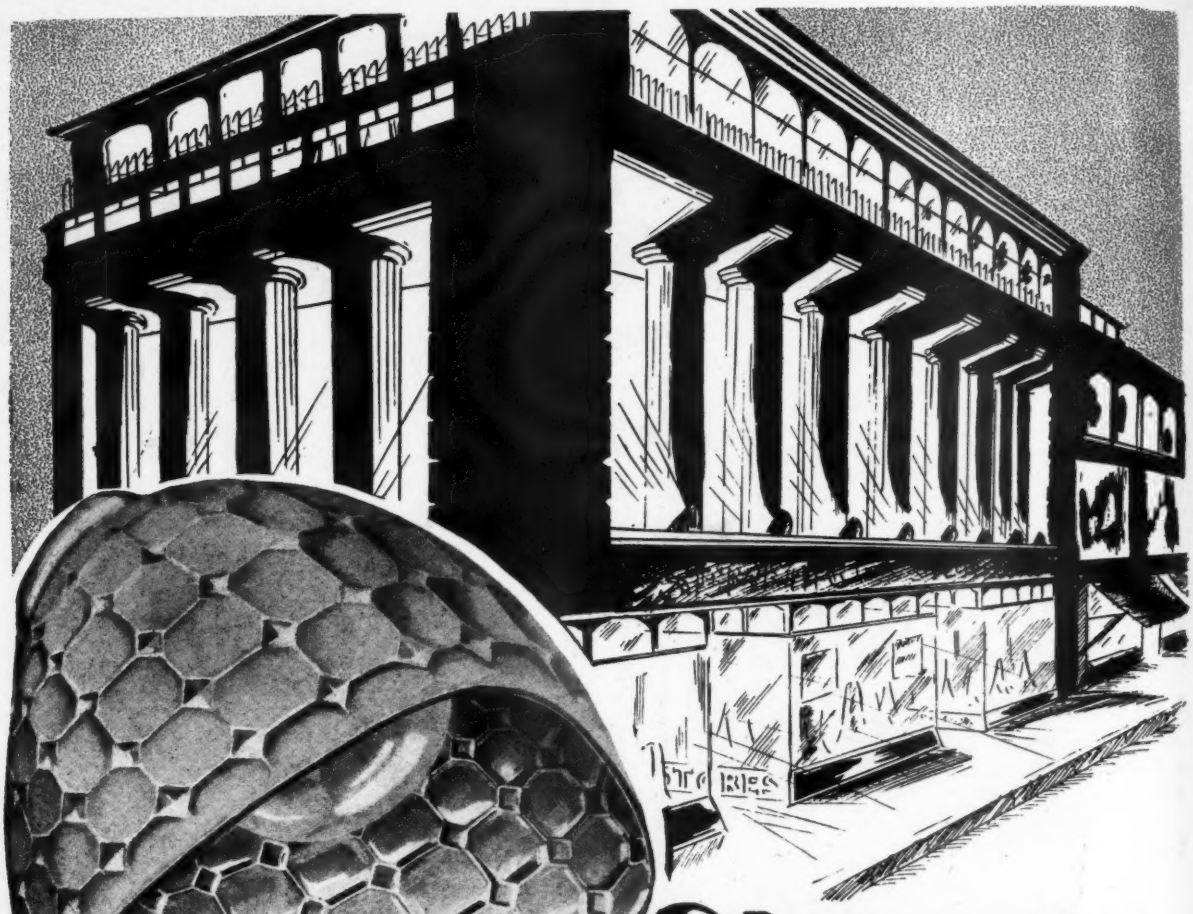

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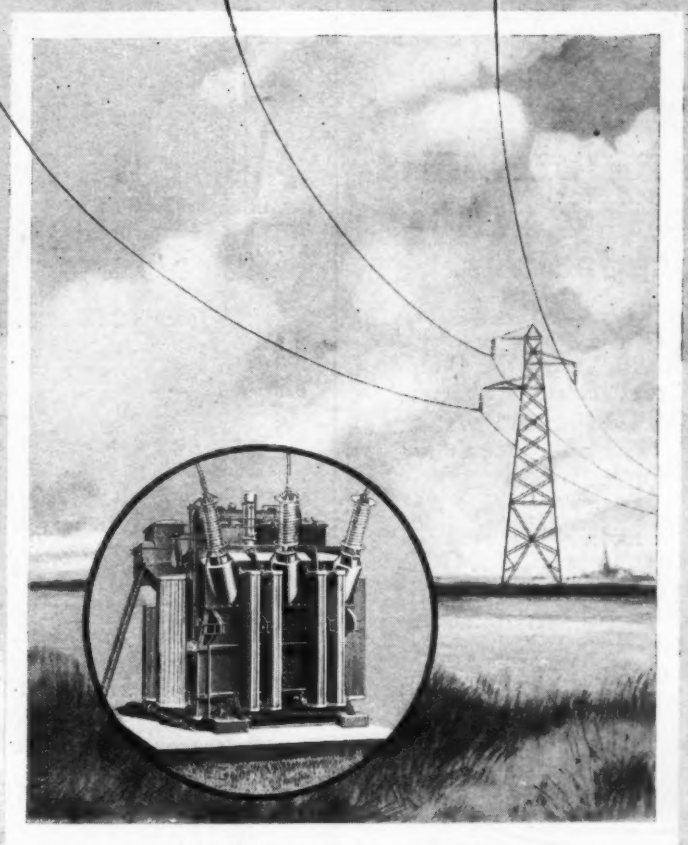

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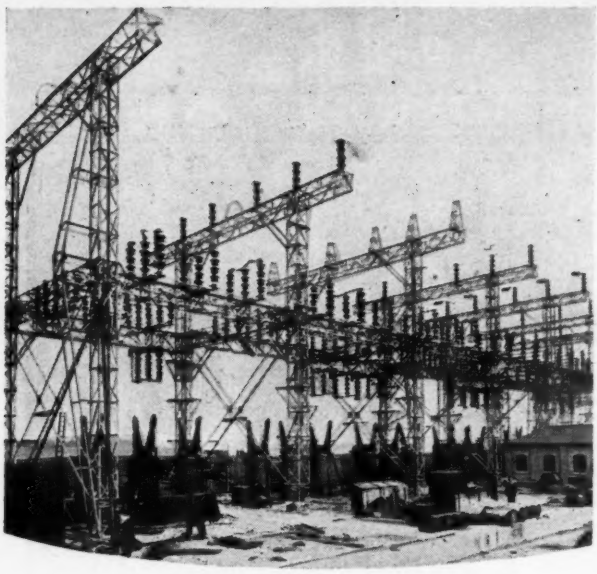

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Above:

A 120,000-kVA 132,000/20,000-volt "Grid" Sub-Station at Dalmarnock, Glasgow, with "Metrovick" E.H.T. Transformers and Switchgear.

Below:

A 10-kVA Metrovick 2,000/400-volt Farm Line Sub-Station with pole mounted Transformer and Switchgear at Honley, Yorks.

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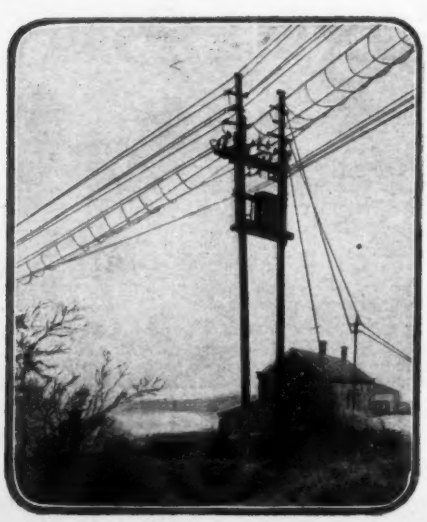
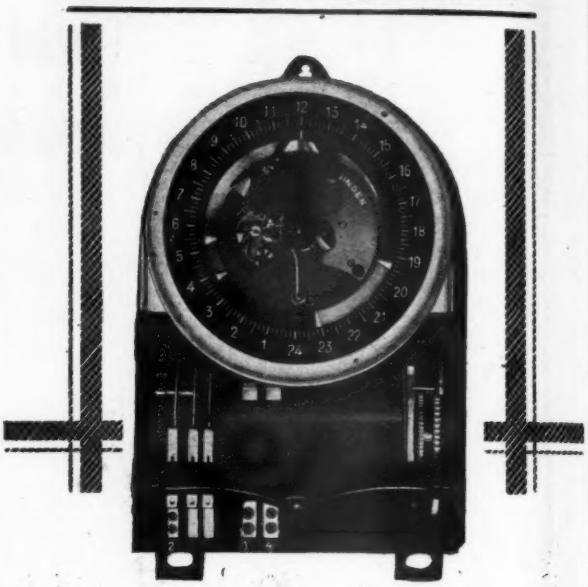


SADIA
SELF WINDING
TIME SWITCHES



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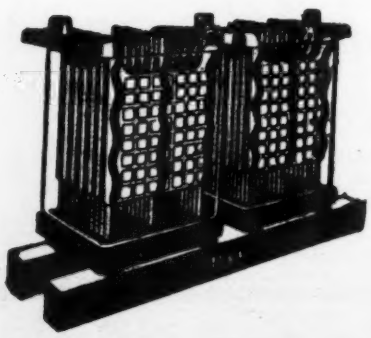
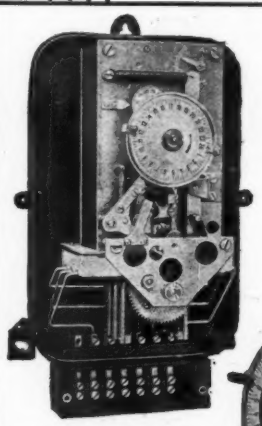


S.B.9.

A·E·G

AUTOMATIC TIME SWITCHES



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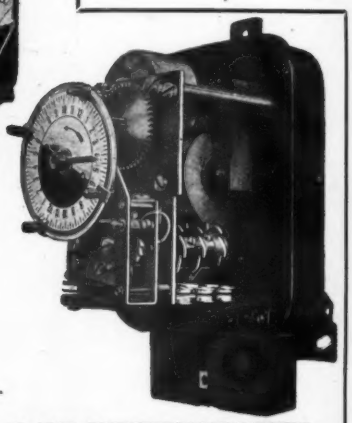

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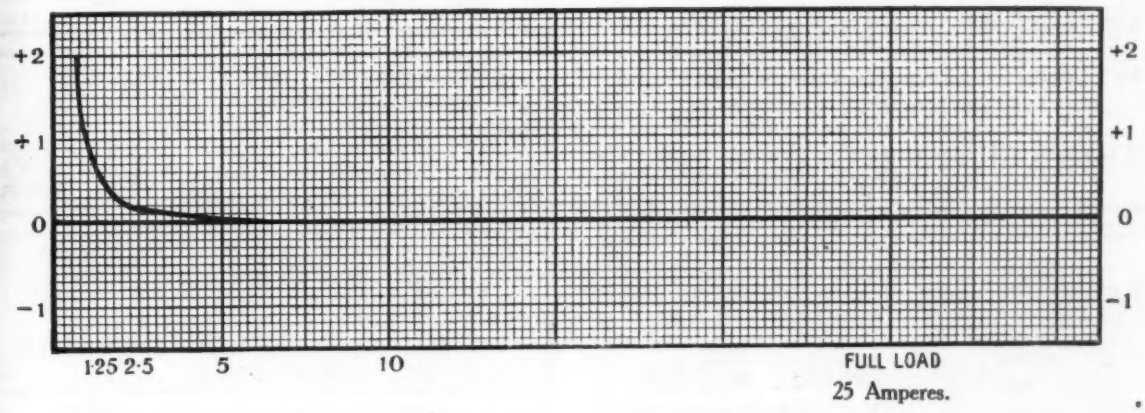

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÷Rotor Weight	26 gm.	=0·0167
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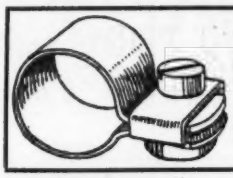
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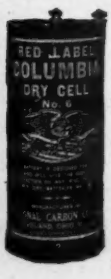

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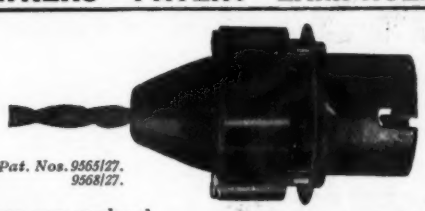

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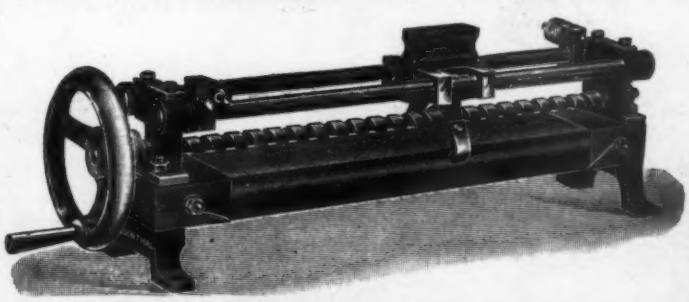

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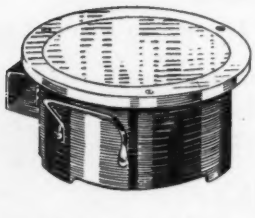

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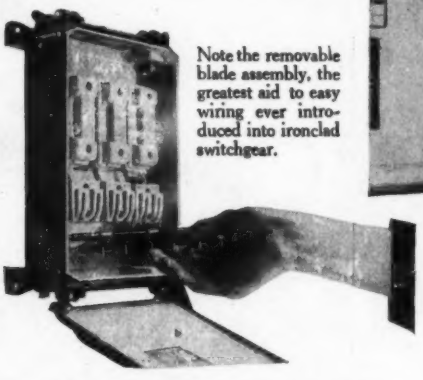

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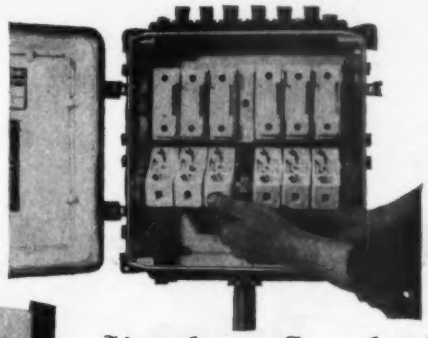

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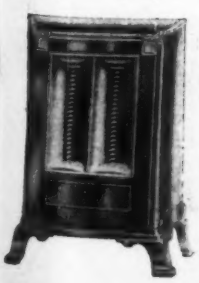

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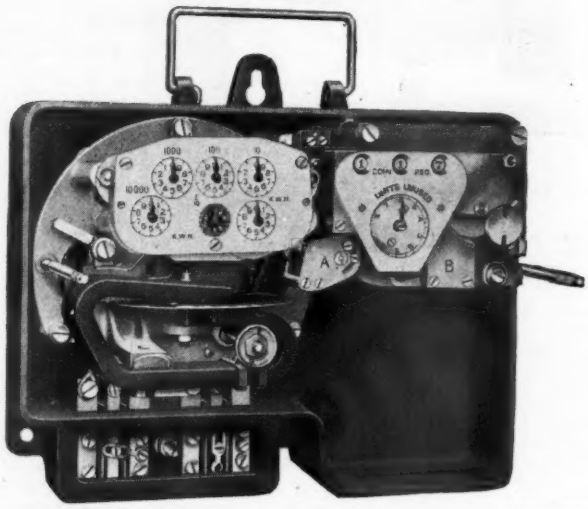
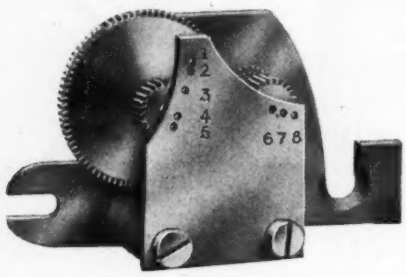
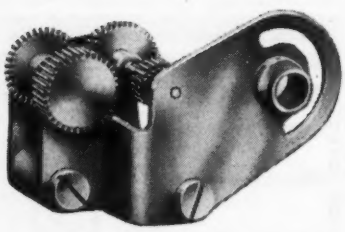




Easy price change gear



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PRICE changes on prepayment meters often involve great expense.

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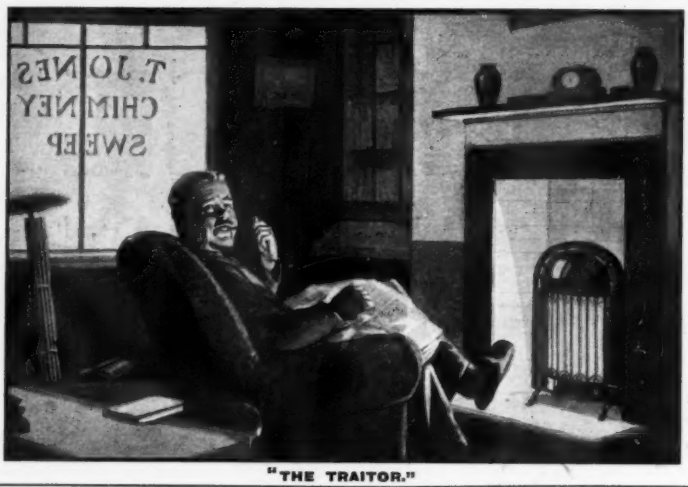

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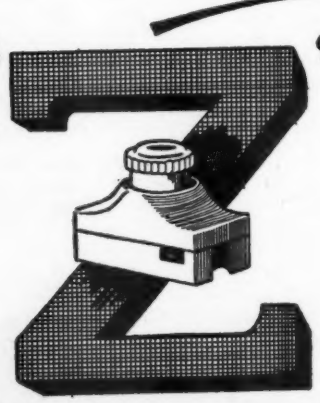

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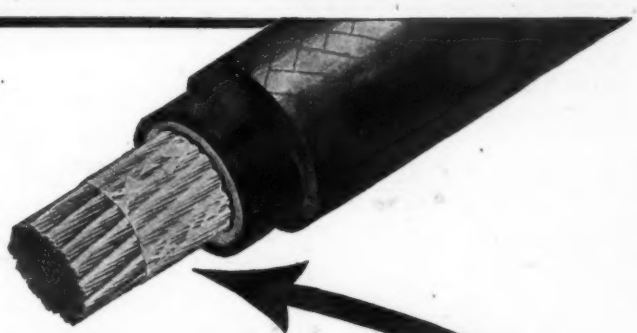

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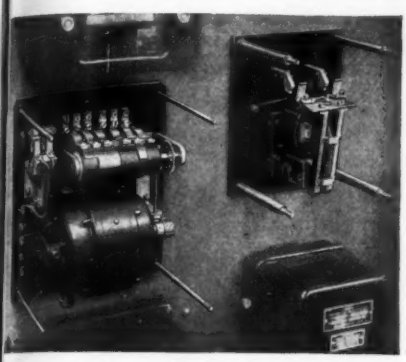

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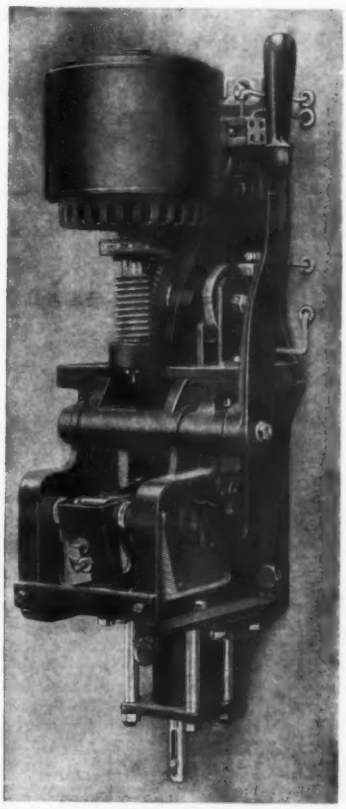

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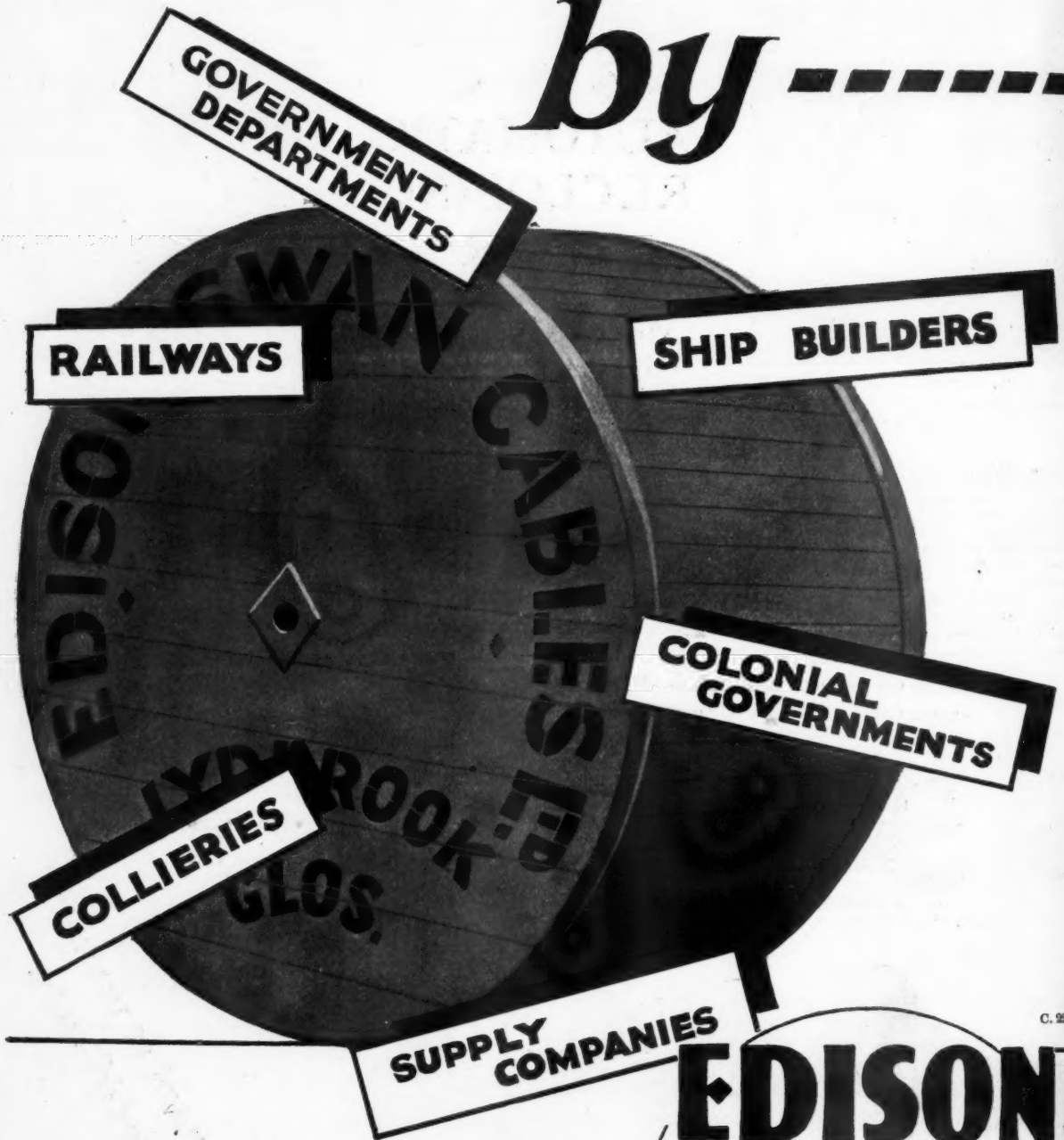

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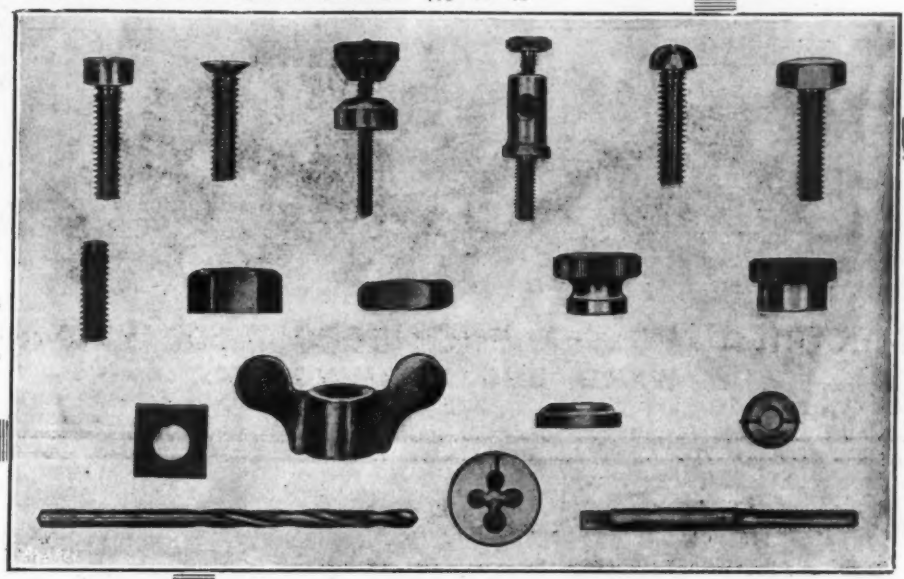

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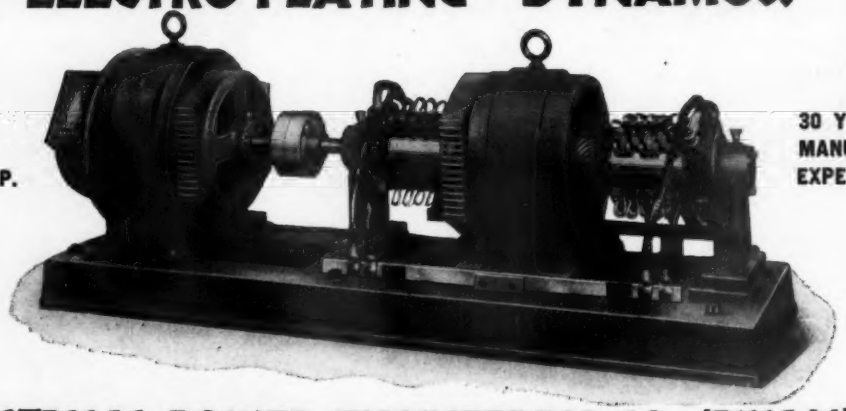

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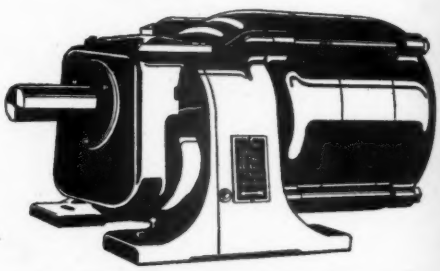

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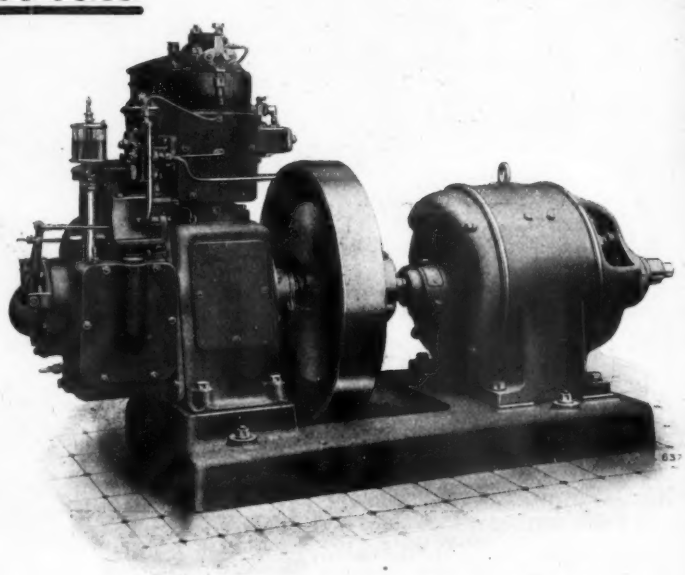

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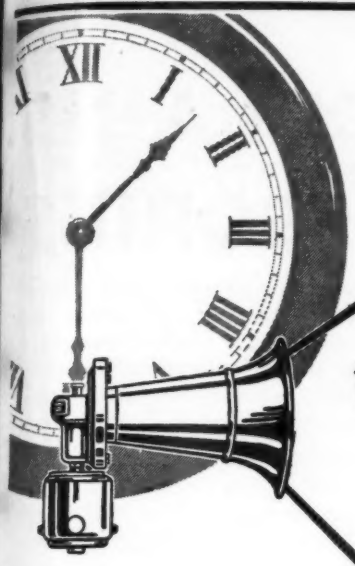

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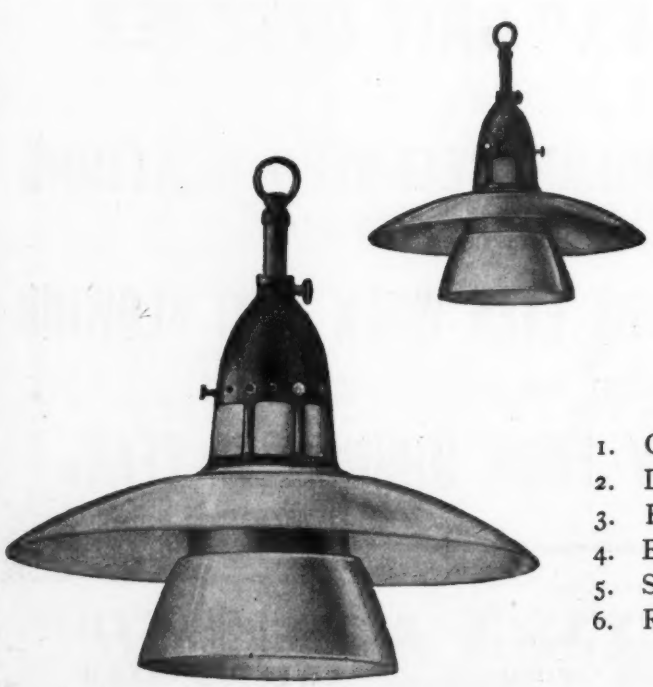

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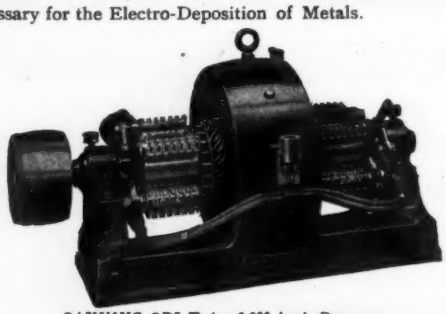

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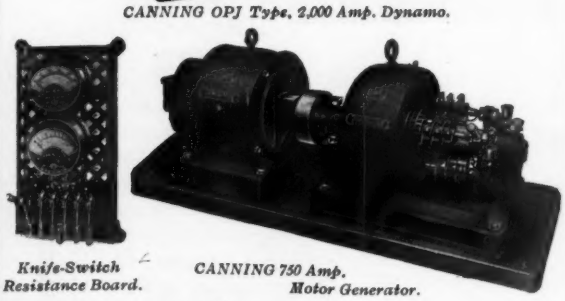

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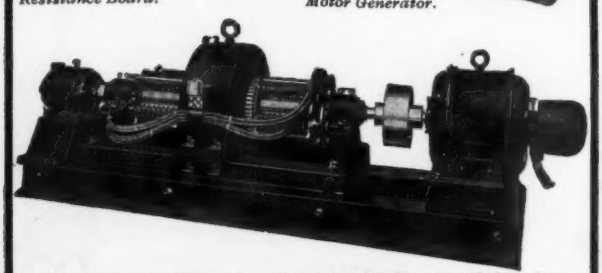

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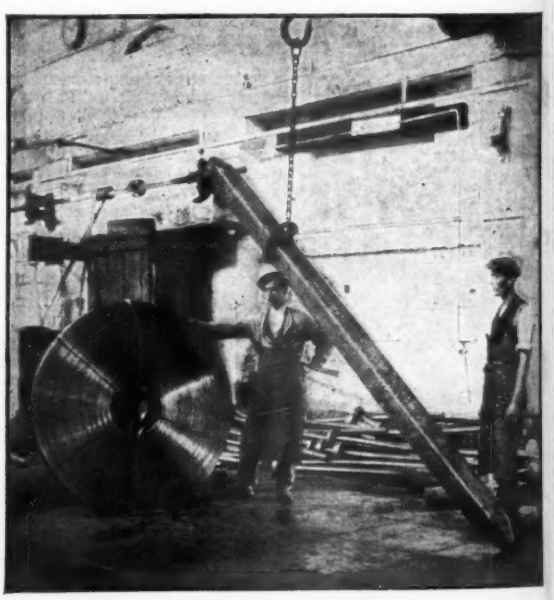

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Electric Kettle
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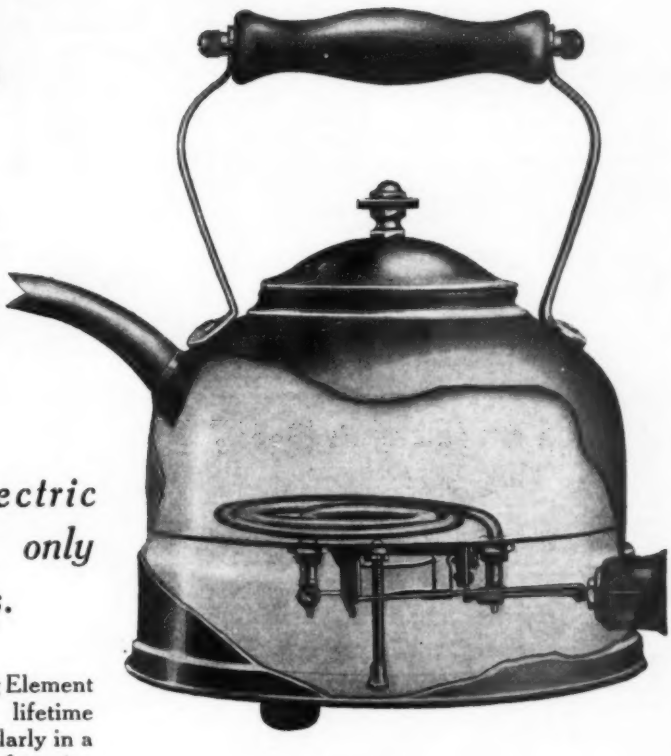

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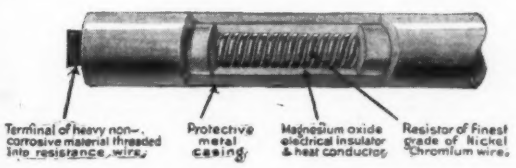
This sectional view shows the typical construction of CALROD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This kettle is only suitable for use on A.C. circuits.

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(59)

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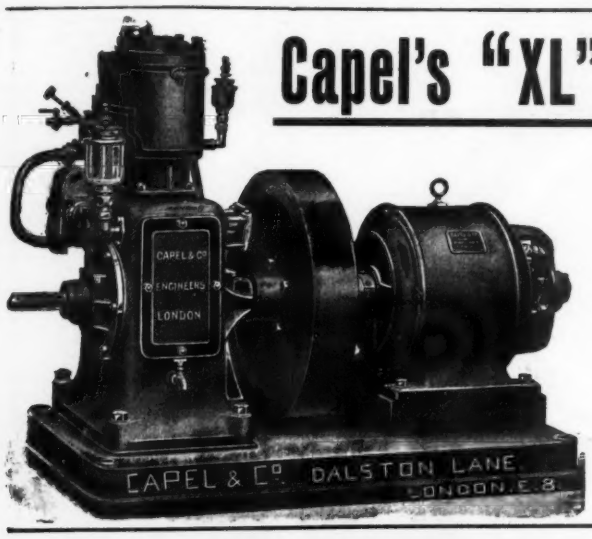

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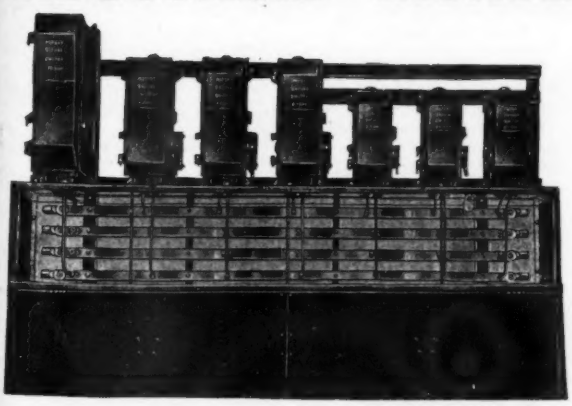

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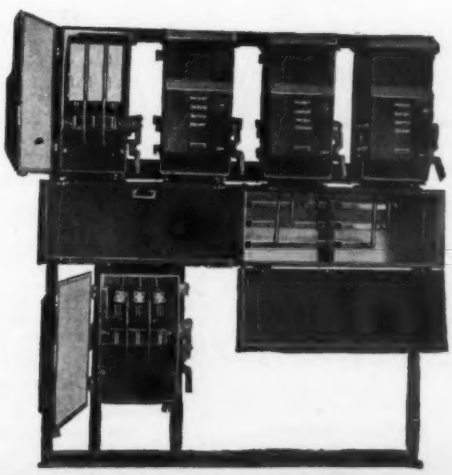

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CONTINUED ON PAGE LII.

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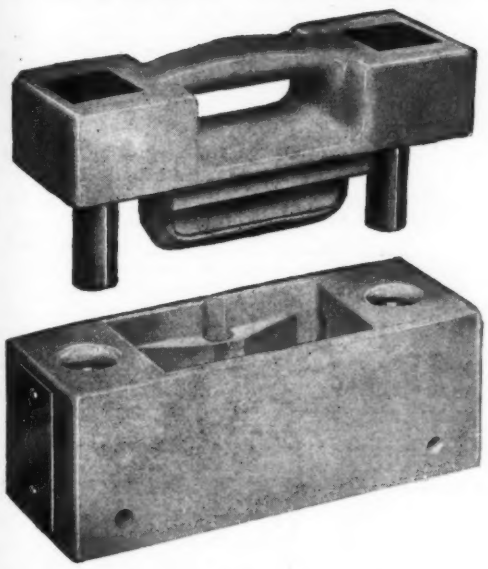

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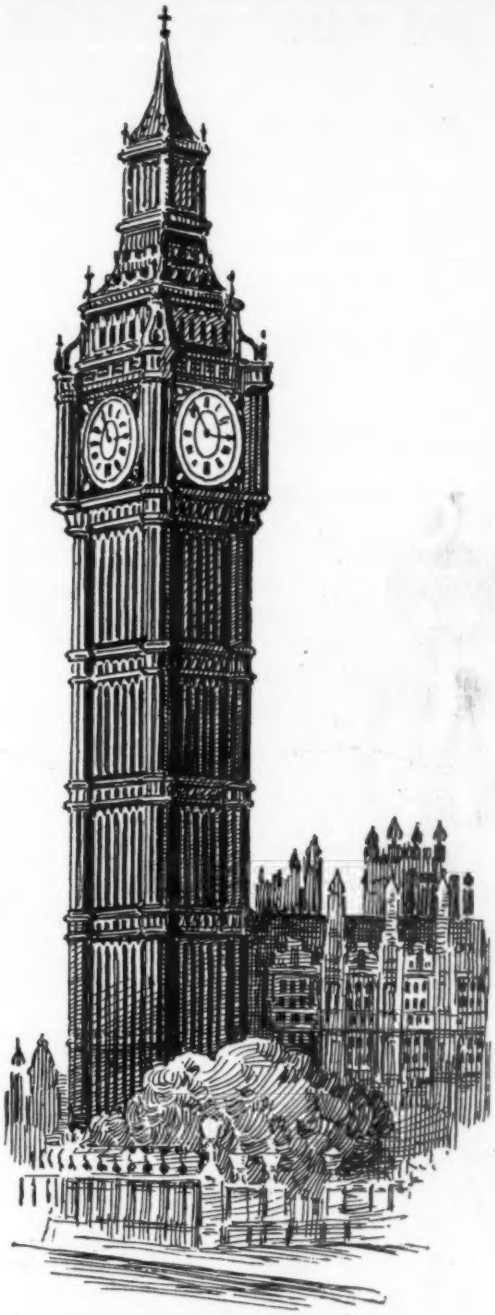

(13)

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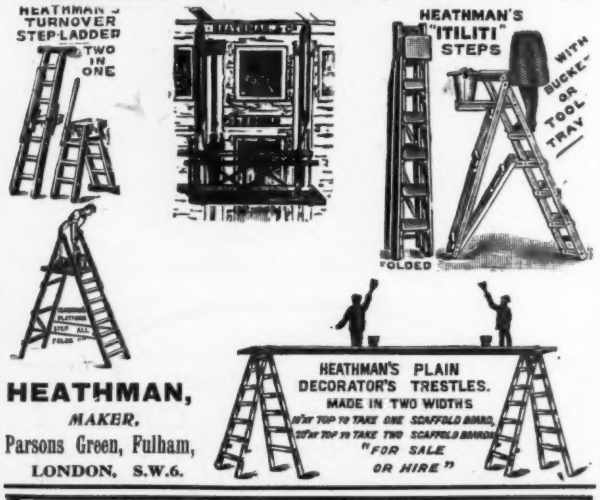

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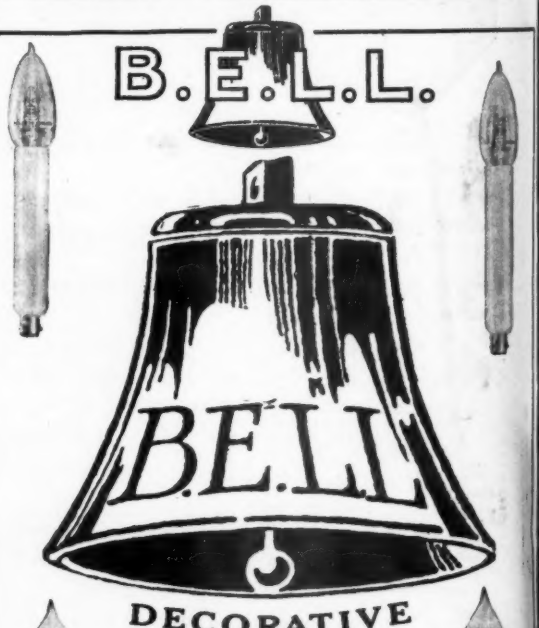

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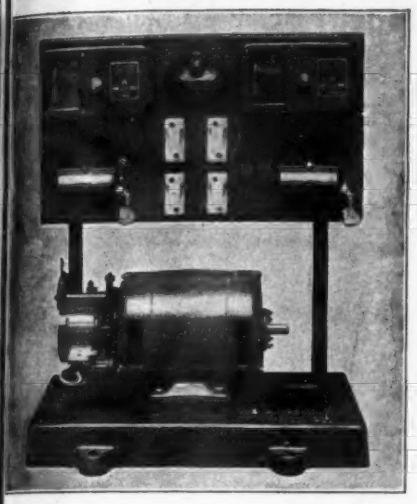

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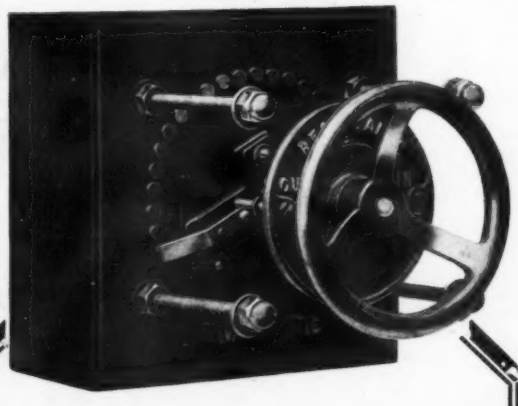

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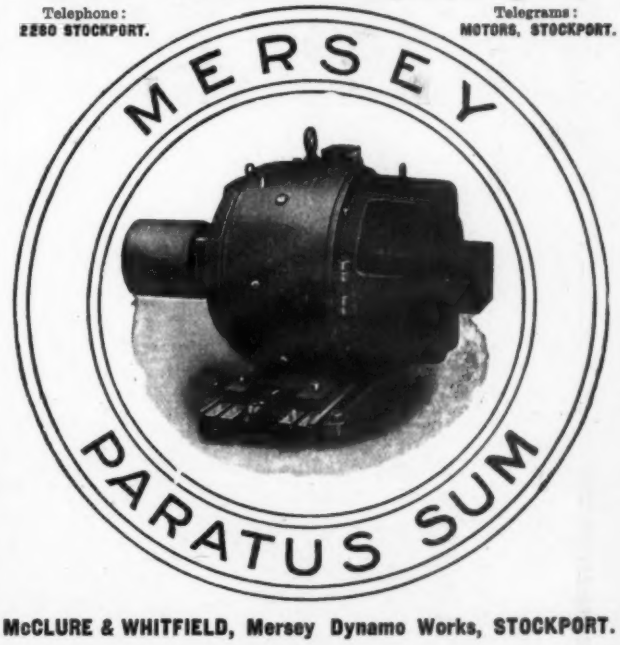

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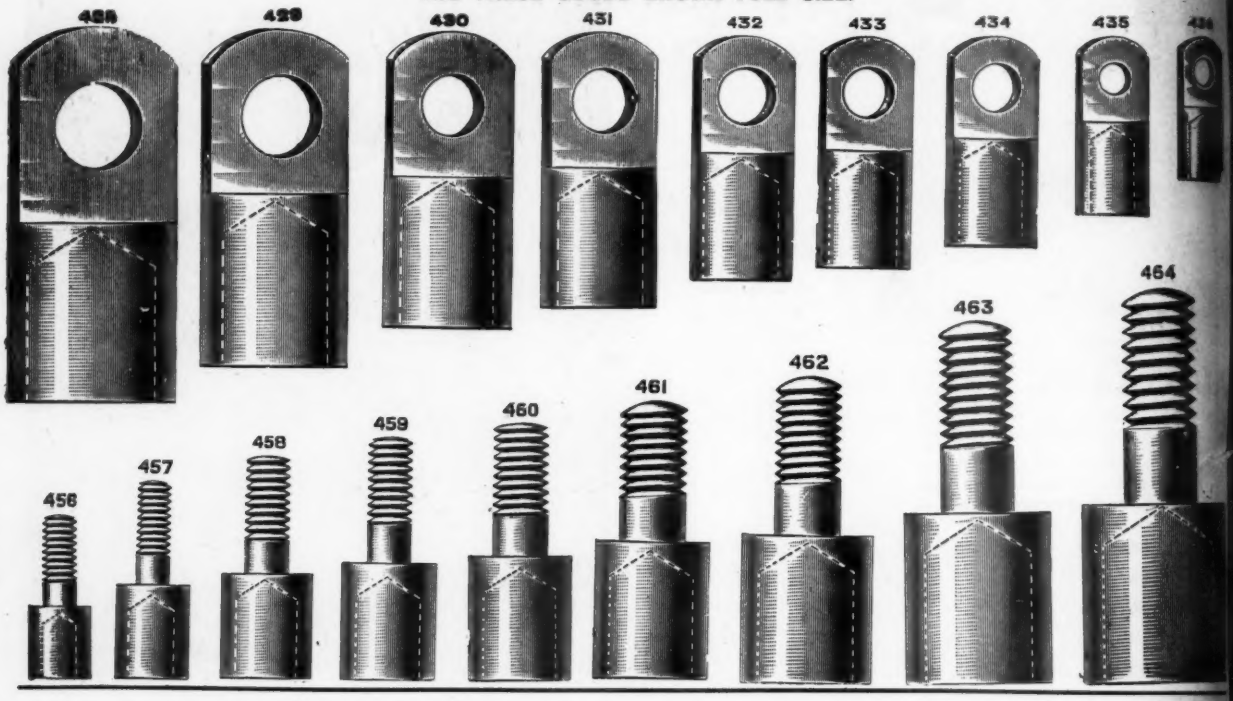

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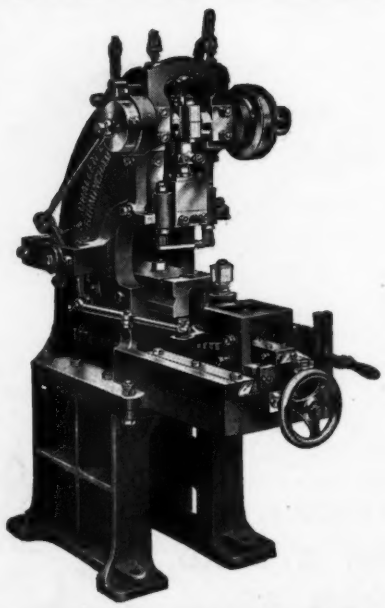

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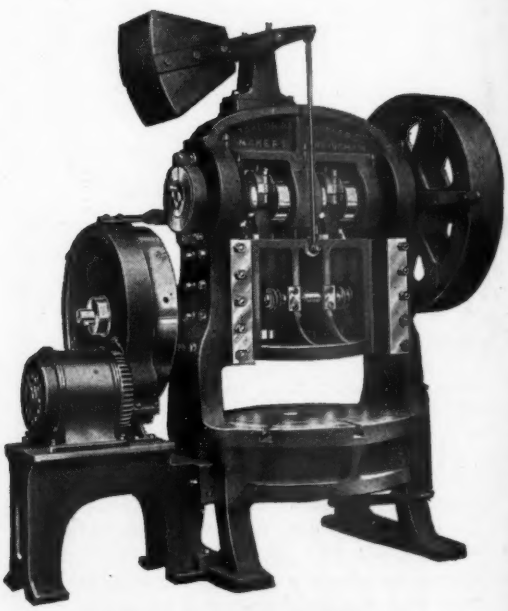

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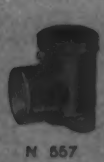

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